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New Steamer Pacific

The Emery Steamship Co's Latest Addition

THE S. S. Pacific built at the yards of the Fore River Shipbuilding Corporation, Quincy, Mass., is the second of the duplicate vessels Atlantic and Pacific building for the Emery Steamship Co. of Boston. She is a steel screw steamer constructed with machinery aft to the design of George Simpson, naval architect, of New York City, and accorded the highest class in Lloyd's registry. The vessel is designed to carry lumber and general cargo between ports on the Atlantic and Pacific coasts via Panama Canal.

The principal dimensions are as follows:

Length over all	405 ft. 9 in.
Length between perpendiculars	388 ft. 0 in.
Breadth molded	54 ft. 4 in.
Depth molded	31 ft. 8 in.

The vessel has a straight stem, semi-elliptical stern and a single steel upper deck, full poop, bridge house amidships and top gallant forecastle.

Accommodations are provided in the midship house for the officers and wireless operator with saloon, pantry, etc., and on bridge deck is the captain's suite and chart room, with the pilot house over same.

The long poop encloses quarters for the fishermen, seamen and petty officers and in the Liverpool house on the poop deck are arranged the quarters for the engineers, with officers' and engineers' mess, galley, etc.

The hull of this vessel is of the single deck type with a deep double bottom for water ballast extending all fore and aft from collision bulkhead. The cargo space is subdivided by transverse watertight bulkheads into three cargo holds, each operated by large twin hatchways fitted with DeRusett patent covers. The cargo holds are exceptionally large and practically free from obstructions, the only pillars fitted being one in the middle of each hold. The vessel is therefore well adapted for carrying lumber or bulk cargo such as coal, grain, etc. The inner bottom plating has been made exceptionally heavy to withstand the bumping of grab buckets.

Arrangement will be made for carrying a large deck cargo of lumber and a port is fitted on each side through shell forward between the upper and forecastle decks for convenience in handling long logs.

The vessel will be rigged with three pole masts and two king posts, twelve 5-ton, and one 25-ton derrick booms being fitted for handling cargo. The

winches, nine in number, are of Lidgerwood Mfg. Co.'s make.

Steering gear, operated by telemotor; windlass and capstan of the most up-to-date type will be fitted.

The propelling machinery consists of a vertical, inverted, triple-expansion engine with cylinders 25 inches, 41 inches and 68 inches diameter, having a stroke of 48 inches, supplied with steam at 190 pounds pressure from three single ended, coal-burning Scotch boilers, 13 feet 9 inches diameter x 11 feet 10 inches long, fitted with heated forced draft on the closed ash pit system. The propeller is of the built up type having a cast iron hub and four cast steel blades.

A 25-ton evaporator will be installed, also a 1-ton refrigeratng machine. The living quarters throughout the vessel will be provided with steam heat.

A complete electric plant will be installed of a 15 kilowatt General Electric Co.'s marine generating set with a combined generating and distributing switchboard, etc., complete, to supply current for one 18-inch searchlight and lighting system throughout the ship, including running and signal lights.

Canadian Car Ferry Leonard

FURTHER particulars are now obtainable of the car ferry Leonard which Cammell, Laird & Co., Birkenhead built for the Transcontinental Railway of Canada and which was briefly described in the December MARINE REVIEW. A noteworthy feature of the ferry is the elevating deck with double railway track whose height can be varied to suit the total range of the St. Lawrence river. The vessel is designed for the special service of transporting passenger railway trains or freight trains across the River St. Lawrence, at all seasons of the year, between Quebec and Levis. The weight of the train to be carried is 1 285 tons. The ferry has been designed so that the time taken in running the train on to the ferry, crossing the river (a distance of 2½ miles), and landing and coupling up the train, will not occupy more than three-quarters of an hour. The principal dimensions are as follows:

Length over all................	326 ft.	0 in.
Breadth, molded	65 ft.	0 in.
Breadth, over fenders.........	66 ft.	9½ in.
Depth, molded	23 ft.	0 in.
Mean draught	15 ft.	0 in.
Speed, statute miles per hr...	15	
I. H. P. of main engines.....	3,200	
I. H. P. of engines for ice-breaking propeller	420	

The vessel is of the twin screw type, with a third ice-breaking propeller at the forward end. She is designed in accordance with the requirements of Lloyd's Register, and is specially strengthened for navigation through ice.

As already stated, the special feature of the design is the elevating car-deck. The railway tracks on the landing berths at Quebec and Levis are, of course, at a fixed level, and the tidal deck can be brought to a level exactly corresponding to that of the land railway terminals, and thus take coaches and locomotives from the fixed tracks at any state of tide, the range being 18 feet. The tidal deck, which is shown at its highest level in the longitudinal section (Fig. 1), is arranged above the main deck of the vessel, and is carried on ten transverse girders, the ends of which each rests on a large nut, and the revolving of a vertical screw causes the nuts to raise or lower the deck through the necessary range to suit the various conditions of the tide.

The tidal-deck vertical lifting-screws are hung from ball-bearings supported on strong columns. These columns are stayed by lattice buttresses and bracing against fore and aft movement, as shown in Fig. 1, while transverse thrusts are provided for, as shown in the transverse section, Fig. 6. Below the main deck again a specially strong-braced strut is built in way of each column, which distributes the load to the keel of the ship (Fig. 6). The main deck and hull are also specially strengthened by additional intercostals, etc., to insure sufficient strength to resist the stresses induced by the heavy loads on the tidal deck. The braced columns below the main deck also serve to carry the worm-gearing for lifting the tidal deck.

Three lengths of track are fitted on the tidal deck, each supported on lattice girders. The length of each track is about 272 feet. At each end of the tidal deck an adjustable hinged gangway is suspended by means of triple purchases from struts fixed on the deck, as shown in Figs. 1 and 3. These gangways are arranged with ball-and-socket joints at the ends of each of the girders carrying the rails, in order to allow for any heel of the ship, or any change of trim, which may take place while the train is passing on or off the ferry. A special motor is arranged in conjunction with each gangway for raising or lowering it. An electric winch with two winding drums is fitted between girders of the tidal deck for hauling the carriages on or off the ship.

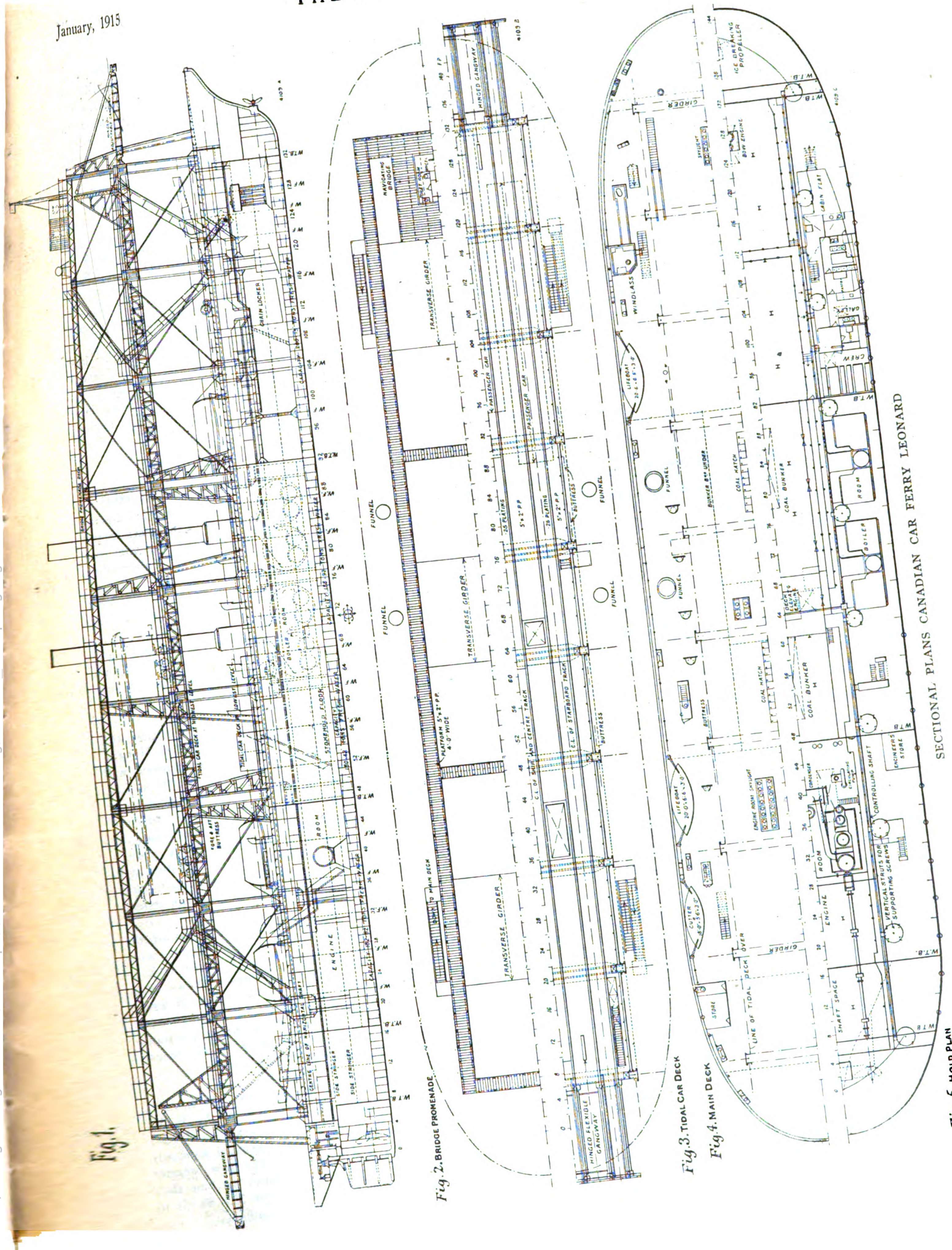
The machinery for raising and lowering the train-deck, which is placed amidships, as shown in Fig. 5, is of special construction throughout. The engine is of the four-cylinder high-pressure type, of massive design, driving through double helical spur-wheels, a second motion-shaft running athwartship. At each end of this shaft mitre-wheels are arranged for driving the fore and aft line shafting arranged on both port and starboard sides of the vessel, Fig. 5. At equal distance along this shafting worm and wheel gearing is fitted for turning the vertical lifting-screws, which are driven through a loose forged-steel sleeve and sliding key arrangement, fitted into the boss of the wheel. Heavy gun-metal nuts, into which the screws work, are fitted into the structure of the train-deck, as already explained, the load coming upon the screws being taken up by special ball-bearings supported by the upper structure of the vessel.

Above the highest position of the carriages on the tidal deck a promenade is arranged all round the vessel, with a bridge platform at the forward end, carrying a pilot-house and chart-room, Fig. 2. This promenade and bridge are carried, on lattice girders supported by the buttresses. Special arrangements are made to prevent any stress which would result from the bending moment on the hull being taken by the girders supporting the promenade.

The main deck, Fig. 4, so far as the part between the vertical screws is concerned, is only a covering for the coal-bunkers, machinery spaces below, and is fitted with skylights and hatches; but when the elevating-deck is at its lowest position it is close down to the main deck level. On each side of the main deck, where space is found for the lattice buttresses, there are lifeboats forward and aft, as shown on the plan, Fig. 4, with companionways to the officers' and crew's quarters below and to the engine and boiler rooms.

Accommodation is arranged for officers and crew on a flat below the main deck forward, on both sides of the ship, everything necessary for full day and night crews being provided (Fig. 5).

The boiler-rooms are arranged in the wing compartments on the port and starboard sides amidships, with



SECTIONAL PLANS CANADIAN CAR FERRY LEONARD

the coal bunkers and tidal deck engine room between them (Fig. 5). The main propelling engines are situated centrally abaft the bunkers, and the engines for the ice-propeller in the hold just abaft the fore peak bulkhead (Fig. 5). A special feed-water tank is built in the double bottom, extending from bilge to bilge for a length of three frame spaces. Ample local stiffening is arranged to allow of the bottom being perforated, to insure a sufficient supply of water when working in ice.

The propelling machinery is of a design which Messrs. Cammell Laird & Co. fit to the large number of merchant ships at Birkenhead, and which has proved of great economy and reliability. The two sets are of triple-expansion surface - condensing type, with cylinders 23 inches, 35 inches, and 55 inches in diameter and a 33-inch stroke, and designed to run at 120 revolutions per minute. A special feature of the machinery is the shafting, which is made throughout much stronger than usual, to stand the "shock" should the propellers strike solid ice. The propellers themselves have also been made especially strong for this reason, and are of nickel steel. At the forward end of the vessel a set of compound surface-condensing engines is fitted, having cylinders 15 inches and 32 inches in diameter x 21-inch stroke, driving a nickel-steel propeller at the bow for clearing ice from the landing stage. This propeller is arranged to run idly when there is no ice. Steam is supplied to all the machinery by eight single-ended boilers working under natural draft, and constructed for a working pressure of 165 pounds per square inch.

A complete installation of auxiliary machinery has been fitted. The pumping and heating arrangements are exceptionally complete, special arrangements being made for heating the railway carriages during transit. The vessel is fitted with electric light throughout. Two powerful steam windlasses are fitted, one on each side of the ship, with slip-drums for mooring.

The hull and machinery, which were made to comply with Lloyd's requirements, were constructed under the supervision of J. E. Hamilton.

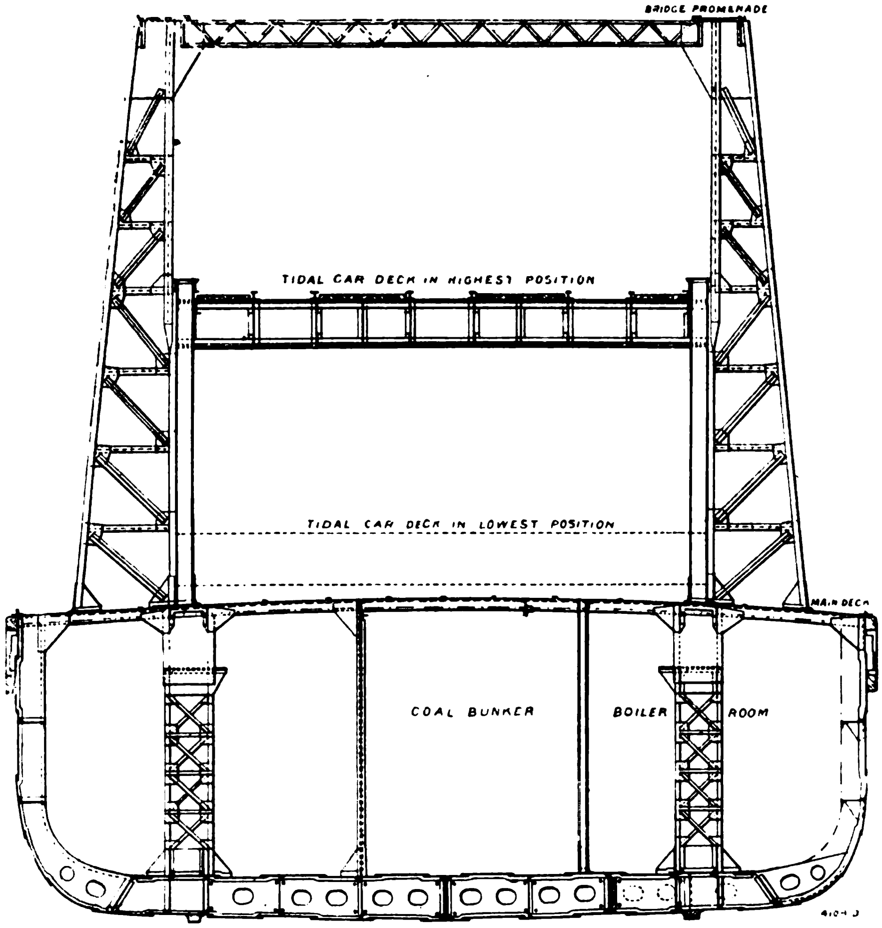


FIG. 6—TRANSVERSE SECTION CANADIAN CAR FERRY LEONARD

Edward J. Howard, Jeffersonville, Ind., has been awarded contract for the construction of the new steel stern-wheel towboat Chalmette by the Mississippi River Commission at New Orleans, at a cost of $19,425.

Iron Ore Assessments

Equalized assessments for 1914 on iron ore properties, stocks, etc., on the Mesabi and Vermillion ranges in St. Louis, Itasca and Lake counties, and the Cuyuna range in Crow Wing county, have just been announced by the Minnesota tax commission. The assessment was increased in general 5 per cent on mined and unmined ore and unplatted mineral lands in St. Louis county and 10 per cent on all unplatted lands in Itasca county. According to the following report of the commission, assessments on iron ores on the Mesabi and Vermillion ranges now are on the basis of 50 per cent of value.

No commercial manganese ore has been developed on the Cuyuna range. There is a considerable quantity of manganese, but so mixed with this iron formation as to make it a manganiferous iron "ore material" of no present metallurgical value.

New Coal Dock at Toledo

A contract has been awarded by the the receivers of the Cincinnati, Hamilton & Dayton railroad for the construction of a modern coal-handling machine at Toledo, O., which will cost about $350,000 and provide additional facilities for handling the road's coal traffic consigned for trans-lake shipment. The capacity of the new machine will be 40 cars an hour, and, replacing the present unloader, the capacity of the terminal will be 3,000,000 tons a season.

The steelwork will be fabricated and erected by the Wellman-Seaver-Morgan Co., Cleveland, and the foundations will be built by the Smith-McCormick Co., Easton, Pa. Work on the improvement will be started at once and must be completed by April 27, 1915, ready for the opening of lake navigation. A feature of the new machine in its operation will entail but a 3-foot vertical lift, thus overcoming breakage to a large extent.

The steamers Yoro and Ceiba of the Viccaro Bros.' fleet, New Orleans, were recently cut in two in the same dock at the yard of the Newport News Ship Building & Dry Dock Co., Newport News, Va., each to be lengthened 40 feet. This is probably the first instance when two vessels were simultaneously lengthened in the same dock.

The Bath Iron Works, Bath, Me., have received contract from the E. W. Bliss Co., New York, for a steel steamer to be 130 feet long, designed expressly for torpedo testing. The new steamer will have a fully equipped machine shop and will carry a crew of 35. She is to be completed in five months.

Breakdowns at Sea

This Article Outlines Their Prevention and Repair. The Four Great Contributary Causes Are Bad Design, Careless Workmanship, Neglectful Supervision and Fatigue of Material

By R. W. Thompson

IN recent years the marine engine has been brought to a high state of efficiency, both thermal and mechanical, yet there remains plenty of scope for improvement in the minor details of the outfit of a modern cargo vessel. The tendency of the engineering world today is to make all machinery as fool-proof as possible, with a view to rendering it as free from breakdown as possible. If we were to visit the engine-room of some large vessel, we should be surprised at the number of valves placed here and there without any indication of their particular duty, or the direction in which they open or close. If the threads on the spindle were exposed to view we might feel quite safe, but with the threads inside the valve chest, who knows whether it is a right-handed or a left-handed thread.

Sometimes we come across valves in such a position that it is impossible to overhaul them, since they foul some permanent portion of the vessel, such as a bulkhead, a beam or a side stringer. There are steam pipes having expansion bends without any means of draining them, which is sure to result in water-hammer and burst pipes; boiler mountings with ⅜-inch gland studs, which either corrode away or the threads strip with very little pressure. We have stuffing boxes which are not deep enough, perhaps only holding two turns of packing. A shallow stuffing box of this description would be best run up with lead, since soft packing will never remain tight. Considerable trouble is given from time to time by the wooden handles which are fitted to indicator cocks, sight-feed, lubricators, drain cocks, etc., as they crack and fall off, due to the intense heat and oil. It is suggested that fibre handles would be an improvement. The foregoing are a few of the minor troubles that would cost practically nothing to remedy. There are several other details of a like nature which will readily come to the reader's mind as needful of attention.

One of the great sources of trouble with the modern surface condenser is the burst or leaking tube. The first intimation of this will be an increase in the water level of the boilers. This is very undesirable, since salt water carries with it scale-forming matter which will be deposited on the heating surfaces and thus reduce the thermal efficiency. A very effective method of stopping small leaks is to pass sawdust into the circulating pump through its pet cocks. The sawdust will be drawn into the leak and thus stop it. If, however, the leak or burst be large, we must stop the engines, shut down the feed check valves, bilge valves and main injection valve, then take off the man-hole door at top of condenser, and also the examination doors at each end, pass a hose pipe into the condenser through the top door and fill it up with water from the sea. The leaking or burst tube will then be discovered, since water will flow from it. During this process tapered soft wood plugs about 3 inches long should be made, to drive into each end of the affected tube or tubes. The condenser must now be emptied, say, by opening the air-pump suction valve door, and all joints be re-made before the engine can be started again.

Loss of Vacuum

Another source of condenser trouble is loss of vacuum. This may be due to one or more of the following causes:—Defective air pump, defective circulating pump and insufficient water supply, leaking glands at low pressure cylinder, division plate broken, leakage of air into condenser (bad joints), air locks in water space. A defective air pump is generally caused by one of the head valves becoming broken or worn out.

On one occasion while passing through the West Indian Islands, the suction and delivery valve division plates collapsed, and immediately reduced the vacuum to nil. The ballast pump was at once set to work as a circulating pump to maintain a vacuum, and for two days these conditions prevailed. However, on gaining the open sea, where there was no risk of running ashore, it was decided to attempt a repair to the circulating pump. This was done by making false division plates out of ¼-inch sheet brass doubled and held in position by tap bolts. On arrival in port, the permanent repair was a similar arrangement, only with cast gun-metal plates.

Leaking glands can be detected by holding a light near to the gland, when, if a leak exists, the light will be drawn towards it. A broken division plate allows the circulating water to pass straight from the inlet to the outlet without the water having passed through the tubes. The condenser will be quite hot at one end and cold at the division plate end. We would repair this by fitting a brass, iron or hard wood division plate, and on arrival in port, rather than condemn the whole door, fit a special iron casting similar to the arrangement before the collapse. However, if the door shows signs of being mushy, it should be condemned.

Air leakage is very often difficult to locate; sometimes it can be heard, and, if not, the lamp test must be resorted to. Air locks consist of a portion of air that becomes trapped in the upper portions of the water side of the condenser, and thus prevents water from passing through the top rows of tubes. By fitting an air cock and thus allowing the water pressure to force the air out, we obtain better conditions.

Deflectors or guides should also be fitted on the steam side of the condenser, so as to bring the whole of the cooling surface into action. By carefully noting the temperatures in and around a condenser, we can draw safe conclusions as to its efficiency. A great deal of trouble is sometimes caused when in shallow rivers, owing to mud and sand being drawn into the condenser and choking it up; however, if an upper injection valve be fitted, we should be able to save the situation by drawing water from a level 10 feet to 15 feet above the main injection. Not having an upper injection valve, and knowing the nature of the river or harbor under consideration, we should previously have filled any available ballast tanks with water, with a view to pumping this water through the condenser while going up river. Sometimes the main injection valve grid becomes choked, due to seaweed; by stopping the engine for a few seconds this obstruction will be almost certain to release itself. A steam connection to the main injection valve box would have blown the obstruction away. Ice is also another

*From a recent address before the Graduate Section of the North East Coast Institution of Engineers and Shipbuilders.

source of annoyance which could be successfully overcome by fitting a steam connection.

To attempt the repair of a broken injection valve spindle without going into dry dock is almost an unheard-of thing, yet it can be successfully carried out in the following manner:—Arrange a tarpaulin of double thickness over the grid and have the four corners fastened to ropes, so as to keep it in position. Then disconnect the injection pipe and allow the valve to be eased off its face, so as to ascertain the success or otherwise of the tarpaulin as a means of keeping the water out. In the case that I have in view the water leaked in for about ten minutes, and then practically stopped, thus allowing the work to be completed.

Shafting

The engine shafting should be thoroughly examined at every available opportunity, both for alignment and for surface flaws and cracks. The alignment is tested by either sighting along the couplings or by removing the bolts and passing testers between the coupling faces, thus detecting any error in adjustment, which should be at once corrected. A ship hogs or sags according to the disposition and weight of the cargo. We should at all times keep a look-out for this, since we may have one or two bearings doing all the work and incidentally running dangerously hot. To remedy this, the bearings not taking weight, should be wedged up till they take their share.

The main shafting should be machined all over, to enable surface flaws and cracks to be detected, and should on no account be covered with paint. Surface flaws should be carefully investigated. It is advisable to drill a small hole at each end of the flaw and thus prevent it from spreading. If possible, we should ascertain the depth of the flaw, and having done so, calculate the net area of the shaft, since it may be necessary to reduce the horsepower until a new shaft can be fitted. We can approximate the volume of a flaw by pouring oil or water into it, keeping a record of the amount absorbed.

If a shaft be broken into two pieces, the ends should be brought together and pieces of plate dovetailed into each portion; this will take the fore-and-aft thrust. We should then fit clamps around the circumference, made out of a square bottom end or a patent coupling. The crank shaft in vessels of moderate power is nearly always made hollow. This is very desirable. Again, we have this hole into which we could fit a bolt or rivet to take the fore-and-aft thrust, in the event of the shaft breaking. The circumference would, however, need to be clamped either by a spare bottom end or some other suitable clamping device.

The tail-end shaft is now generally fitted with a continuous brass liner about ⅝-inch thick, shrunk on to the shaft and held in position by brass or gun-metal set screws which are flush with the liner. Corrosion is one of the principal defects which occur in tail-end shafts, and may be looked for at the beginning of the tapered portion of the shaft adjacent to the liner. If the engine runs in a right-hand direction it is advisable to fit a left-hand screw and nut on the propeller shaft, as the tendency will then be for the nut to tighten up on the propeller. Crank shaft webs occasionally burst, owing to the excessive strain set up in the web after the pin has been shrunk in. They are repaired by passing bands around the web or by plate patches.

A burst steam pipe may be due to a number of causes. Water hammer; local extension of material and then rupture; pipe being too rigid and no allowance for expansion and contraction, the material gradually becoming "fatigued," and thus no longer able to carry the test pressure; defective brazing. The pipe must be isolated from the pressure if the burst or crack is very large. We have the option of fitting a joint over the crack and then clamping this in position by one or more bands passed around the pipe; or we can put a cement muff over the affected part with wire binding. This has in the past given satisfaction. If the brazing has given out, we may cut the flange off completely from the pipe, and if we have not sufficient pipe to join up again after taking what we can out of the expansion bend, we must fit in a distance piece.

Piston Rods

A piston rod may become bent, due to overheating, and this may be brought about by several causes—engine out of line (fore-and-aft); gland not screwed up parallel; insufficient or no lubrication; too much play between guide shoe and face. The only way to straighten a bent piston rod in place without running grave risks is to let the engine come on to the bottom center, and then heat the concave side, and at the same time keep the convex side cool by means of a water service; the idea being that the lengthening of the fibres of the concave side will pull the rod back to its normal condition; this may be assisted by the careful use of bottle jacks. Piston rods sometimes wear oval in section, due to the first and fourth causes stated, and also to the rod having soft places running the full length on one side. Rods are very often scored, due to bad packing and subsequent inattention.

Propellers

Nearly all ships carry a spare propeller and tail-end shaft. The propeller we may find in one of the after holds, or in the 'tween decks, or on deck; this latter would seem to be the proper place, since otherwise it would be necessary to unload the vessel to get at it. The spare tail-end shaft we may find in the 'tween decks or in the poop; it should, however, be in the tunnel recess ready for an emergency. The present way of removing the tail-end shaft out of the tunnel is by taking off a portion of tunnel plating, after having discharged the cargo. This entails a considerable loss of time, probably three or four days. It would, therefore, seem an advantage to have the tunnel recess so constructed that the shaft may be removed through the ship's side. This might require a frame to be cut to allow the coupling to pass through; the aperture thus caused being sealed up by a water-tight cover, removable from the inside.

Formerly, if a piece of one propeller blade was broken off, the others were cut off to match the broken one, and thus preserve a balance. Since the introduction of successful electric welding, however, it is usual to weld a new piece of blade on. In one case, owing to the propeller having struck some floating logs, all the blades were broken. In this condition the ship was making about 2½ miles per hour, and the distance to travel was about 2,500 miles. A land-locked bay being within 60 miles, it was decided to go there and try and fit the spare propeller. The nearest dry dock was about 600 to 700 miles away.

Having found a suitable anchorage, the vessel was tipped until the propeller boss come out of the water. The propeller nut was then eased back about two threads, and the shaft in the tunnel shored up so as to take the strain when the wedges were driven in between the propeller boss and the stern post. A stage was rigged under the stern, from which to conduct operations. After several blows on the wedges the propeller was started back. During these operations preparation had been made to take the weight off the propeller when the shaft was ready to be drawn in. The strongest blocks available were used, and through these were reeved the wire mooring ropes, the loose end of which was taken to a winch. Two sets of blocks were used, each having its own winch. Special wire slings were hung over the counter, one port and one starboard, and from these the blocks were hung. The slings to lift the propeller

were then shackled to the lifting blocks. The winches next hauled in the available slack, and the shaft was drawn in. The propeller was then hauled up clear of the water, and a raft floated into the space, on which the propeller was lowered and towed around to the ship's side.

The broken propeller having been lifted on board, the new propeller was then lifted over the side and lowered on to the raft. Care had to be exercised in doing this, as the vessel was rolling somewhat, and the risk of one of the blades piercing the ship's skin great. In due course the propeller was slung into place, the shaft again pushed out, the nut put on and driven up hard, and the split pin put in and opened. The tunnel shafting was then rolled into position and coupled up, and the stern gland repacked.

Rudders

The rudder post very often shears off close to the quadrant, and if the break protrude from the stuffing box we may be able to clamp the two portions together or cut a fresh key-way in that portion of the post protruding from the stuffing box, fix the quadrant on it and alter the chain leads to suit. If the break occur in the rudder trunk, we should be forced to disconnect the upper portion of the rudder post and attempt to scarf or weld the two portions together. Rudders and temporary rudder posts have been made out of pieces of angle iron and wood with some considerable amount of success.

Assuming that we have no rudder at all, it is possible to steer the vessel by means of a long rope which is towed astern, the rope having a float fitted to its after extremity, and from this guide lines are lead to the hawse pipes on port and starboard quarter and thence to winches. A lifeboat full of water raised or lowered on each side as occasion may require has the same effect.

Stability of Vessels*

Their Buoyancy Discussed as Affected by Damage Due to Collision—Extension of Bulkheads to Hurricane Deck

By William Gatewood

STABILITY is a subject which should receive consideration before the dimensions of a vessel are settled. The height above base line of the initial metacenter can be determined, with a fair degree of accuracy, by the use of coefficients. A convenient formula is—

$$\text{Metacenter above base} = aH + c\,\frac{B^2}{H}$$

In this formula H represents the draught and B the beam of the vessel; aH is the height of the center of buoyancy above base and $c\,\frac{B^2}{H}$ is the height of the metacenter above the center of buoyancy. For coastwise passenger and freight steamers of modern design having fine load waterline forward and full amidship section, the coefficient a will vary between .57 and .54, depending on coefficient of fineness and exact shape of lines, and decreasing for the same vessel about .01 as the draught increases from 12 feet to 24 feet. For the same type of vessel, the coefficient c will vary between .078 and .082, depending on the exact shape of the load waterline and the fineness of the vessel. For the older vessels, with considerable deadrise and with V-shaped lines forward, both coefficients will be found to be greater. If they had not taught that increase in beam does not, *ipso facto*, imply increased resistance to motion, the model tanks could be blamed for a reduction in metacentric height on passenger steamers, because they are responsible for small deadrise and for fine load waterlines forward on vessels which are designed to obtain a good speed on small horse-power.

The determination of the height of the center of gravity above base cannot be approximated so readily. The vessel as completed and loaded, can be considered as composed of six items:—

1. The hull and fittings below the highest continuous deck.

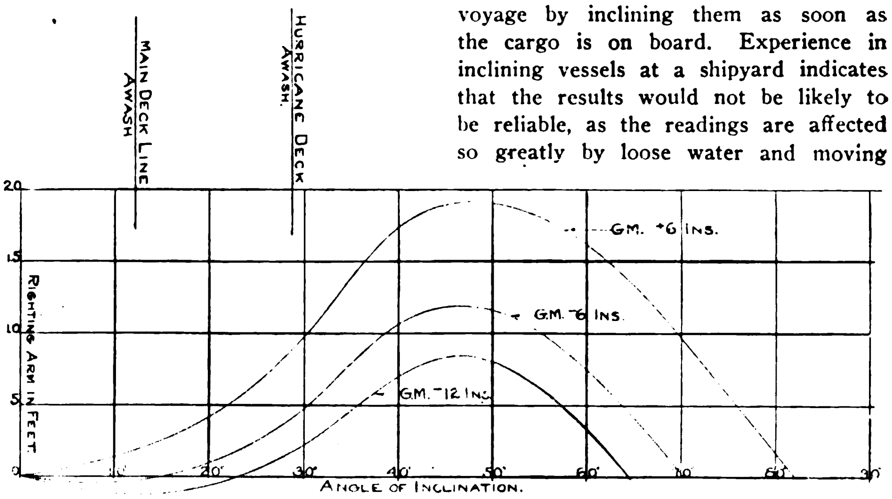


FIG. 1—STABILITY CURVE 370 FT. STEAMSHIP, INTACT, 21.7 FT. DRAFT

2. The hull and fittings above the highest continuous deck.
3. The machinery.
4. The fuel and water.
5. The passengers, crew and stores.
6. The cargo.

In the preliminary stages of the design, an approximation of the weight and vertical center of gravity of each of these items may be made, and the results combined, in order to get an approximate figure for the height of the center of gravity of the loaded vessel. An inclining experiment made on the vessel when completed will serve to eliminate uncertainty as to some of the items, generally the first three. The last three items are variable quantities, and must be figured, at best. It has been proposed to determine the metacentric height of vessels before each voyage by inclining them as soon as the cargo is on board. Experience in inclining vessels at a shipyard indicates that the results would not be likely to be reliable, as the readings are affected so greatly by loose water and moving people. Greater accuracy is likely to be reliable, as the readings are affected so greatly by loose water and moving people. Greater accuracy is likely to be obtained by determining beforehand how much weight of cargo is to be stowed in each division of the vessel in order that the center of gravity of the cargo may not exceed a certain height above base considered desirable

*Paper read at meeting Society of Naval Architects and Marine Engineers, New York, Dec. 10 and 11, 1914.

in order to obtain a predetermined minimum metacentric height under the most unfavorable conditions of bunkers likely to occur on the voyage.

This leads up to the question:—What is the minimum metacentric height for any vessel consistent with safety? The question is susceptible of several answers, depending on whether the vessel is considered as intact and exposed to storm and waves, or as "damaged" either in still water, in a moderate sea, or exposed to storms.

In general, it may be stated that passengers prefer a vessel with a long period of roll, as the discomfort is much reduced thereby. To obtain a long period it is necessary to have a large vessel or a small metacentric height; and the combination of the two requisites in the large Atlantic liners renders travel on them a pleasure instead of a bugbear to the landsman with a "sympathetic" stomach. If the small metacentric height is accompanied by a high freeboard and a considerable range of stability, there is small danger of capsizing, due to wind and waves, while "intact." This "comfortable" condition of a vessel, however, may be a source of great danger even in still water if the vessel is damaged by collision.

To illustrate the conditions obtaining, a coastwise passenger steamer 370 feet long, 49 feet 6 inches beam, and 35 feet deep to hurricane deck, has been selected. The vessel is considered as subdivided in accordance with the regulations proposed by the International Convention on Safety of Life at Sea of 1913-14, as a vessel engaged in a mixed cargo and passenger service. The load draught allowed with bulkheads extending to the main deck (the lowest point of which is 26.92 feet above base) and with machinery compartment 65 feet in length, is 21.7 feet. At this draught it is assumed that the cargo is so loaded that the metacentric height is 6 inches. The range of stability, as shown on Fig. 1, figures out at 82 degrees, and the maximum righting arm is 1.9 feet at 48 degrees inclination. It would be a pleasure to sail on this vessel under such conditions.

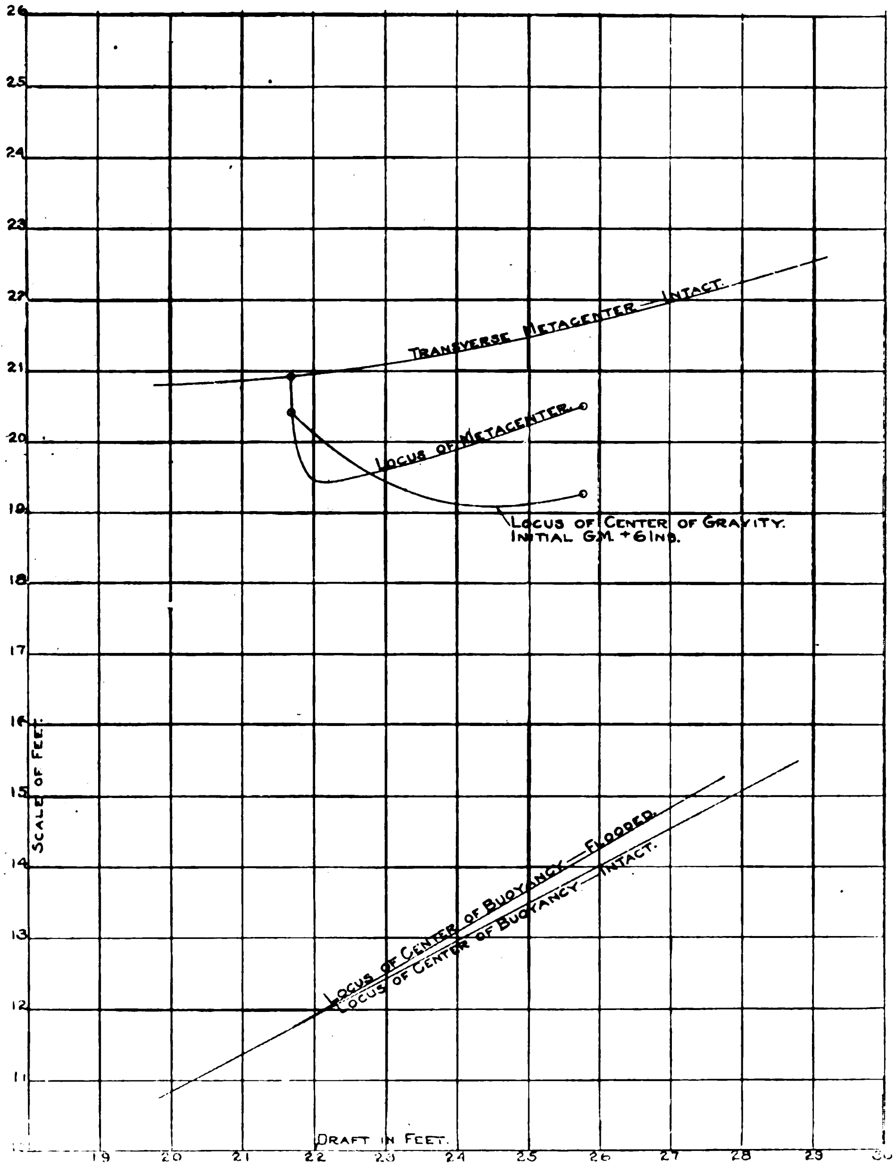


FIG. 2—VARIATION OF INITIAL STABILITY IN FLOODING MACHINERY COMPARTMENT

Now let us suppose that the machinery compartment is opened to the sea by collision, that the permeability of this compartment is 0.80, that the water surface in the damaged compartment at all stages has an inertia coefficient of 0.80, and that the water has free access across the compartment. As the compartment fills, the center of gravity of the vessel and contained water would fall as indicated by the line marked "Locus of center of gravity" Fig. 2. The center of buoyancy would rise as indicated by the line marked "Locus of center of buoyancy." The metacenter would fall as indicated by the line marked "Locus of metacenter."

A condition of unstable equilibrium is indicated almost as soon as the water begins to enter the vessel. If the vessel remained upright so that the center of gravity of the entering water would be on the center line of the vessel, this condition of instability would continue only until the compartment was one-third full and a draught of 23.1 feet was attained. The metacentric height would rapidly increase as additional water entered, and would become as much as 1.1 feet at 25.9 feet draught, when the water would cease to flow in, having attained its level. The freeboard to main deck in this condition would be about 12 inches, and there would appear no reason why the vessel should not stay afloat in a perfectly calm sea, although the margin of safety as regards freeboard would seem insufficient except under ideal conditions of sea and weather.

But the combination of unstable equilibrium and the inflow of water from one side would surely cause the vessel to list toward the damaged side. This list would continue to increase even after there was a positive metacentric height indicated by the diagram, owing to the fact that the center of gravity of the flooding water would lie toward the low side, as obstructions would prevent a rapid flow across the compartment. Fig. 1 shows that the list caused by the negative *GM* would cause the main deck at the side to be submerged. When the main deck at the side is submerged the water will flow forward and aft along the deck and flood the adjacent compartments, as well as further lower the metacenter. The list will continue to increase, and the vessel to settle deeper in the water and finally sink. The time elapsing from moment of damage to complete submergence would depend on a number of circumstances, but recent collisions have shown that not over fifteen minutes is sufficient.

After complete submergence, there would be a righting moment due to the fact that the materials of the houses, etc., would be of less density than the material of the main hull. The cargo might be of such varying density as to give a righting moment also. It is probable, therefore that as the submerged vessel rests on the bottom she would approach a vertical position with masts upright, or nearly so.

From Fig. 3 it will be noted that the conditions are not far different when No. 2 hold, 76 feet in length, is flooded. Permeability is taken at 64 per cent.

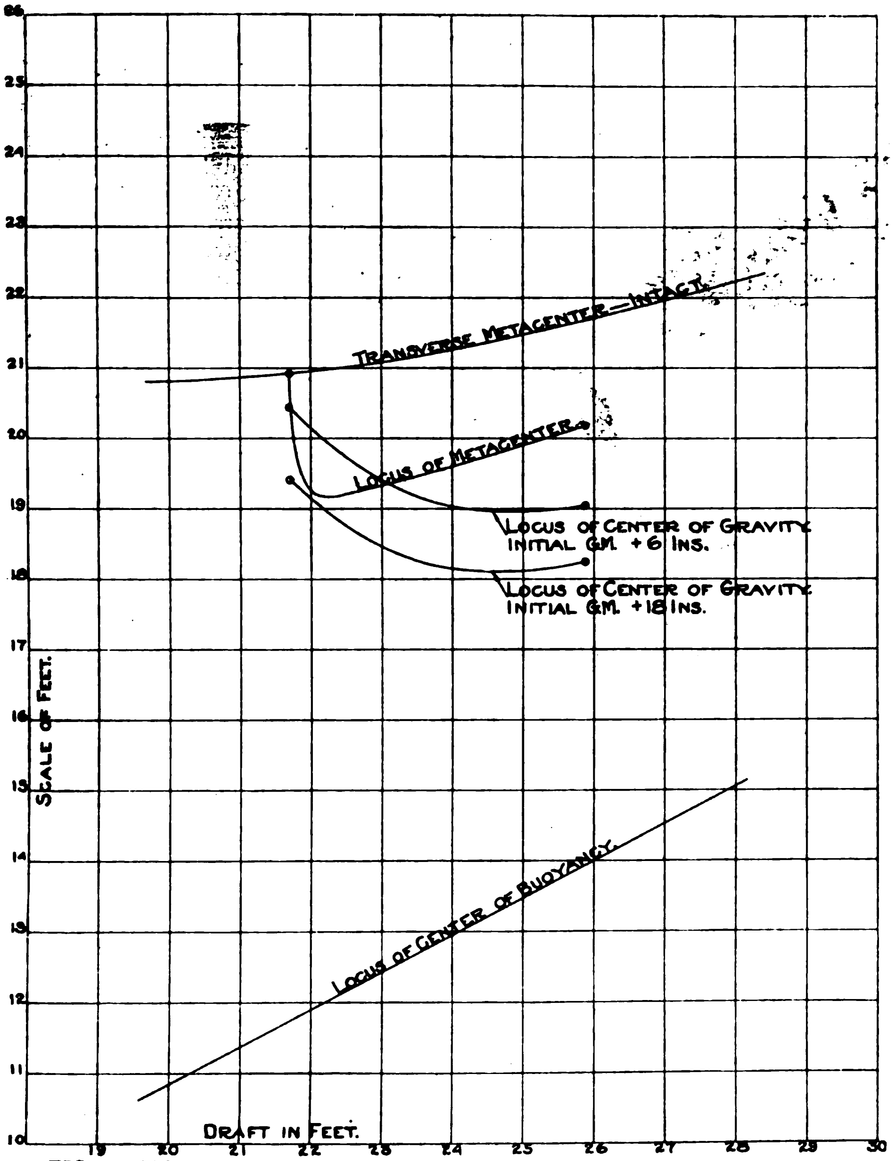


FIG. 3—VARIATION OF INITIAL STABILITY IN FLOODING NO. 2 HOLD

It would appear, then, that in order to prevent this vessel from overturning when one compartment is open to the sea by collision, it is necessary that the initial metacentric height should be sufficient to prevent a condition of instability in any stage of the flooding. For the particular vessel which has been investigated, the initial metacentric height must exceed 1.4 feet by a margin sufficient to allow for the upsetting moment caused by the fact that in the process of flooding an excess of water will be on the damaged side.

If this vessel has an initial metacentric height of say 2 feet, and is subdivided in accordance with the rules of the International Convention, and when at the draught allowed by those rules is injured in a collision, with the consequent flooding of the machinery space or of an adjacent hold, the danger of overturning would seem to be eliminated, provided the sea is smooth. But if the permeabilities established by the conference represent average practice, the freeboard to the top of the bulkheads will be only about 12 inches. It would appear that, if the cut in the side is of any size, a very moderate sea would serve to send the water forward and aft of the damaged compartment, over the tops of the bulkheads.

The results of this investigation would seem to show two things:—

First, for a coastwise passenger and freight vessel of the hurricane deck type, subdivided in accordance with the rules of the International Convention as a Class B vessel, and having a machinery space or holds of about one-fifth the length of the vessel, an initial metacentric height of not less than 18 inches should be an important element of the design.

Second, greater safety would be obtained by extending the bulkheads to the hurricane deck, or by otherwise preventing the flow of water fore and aft on the main deck.

New German and Austrian Warships

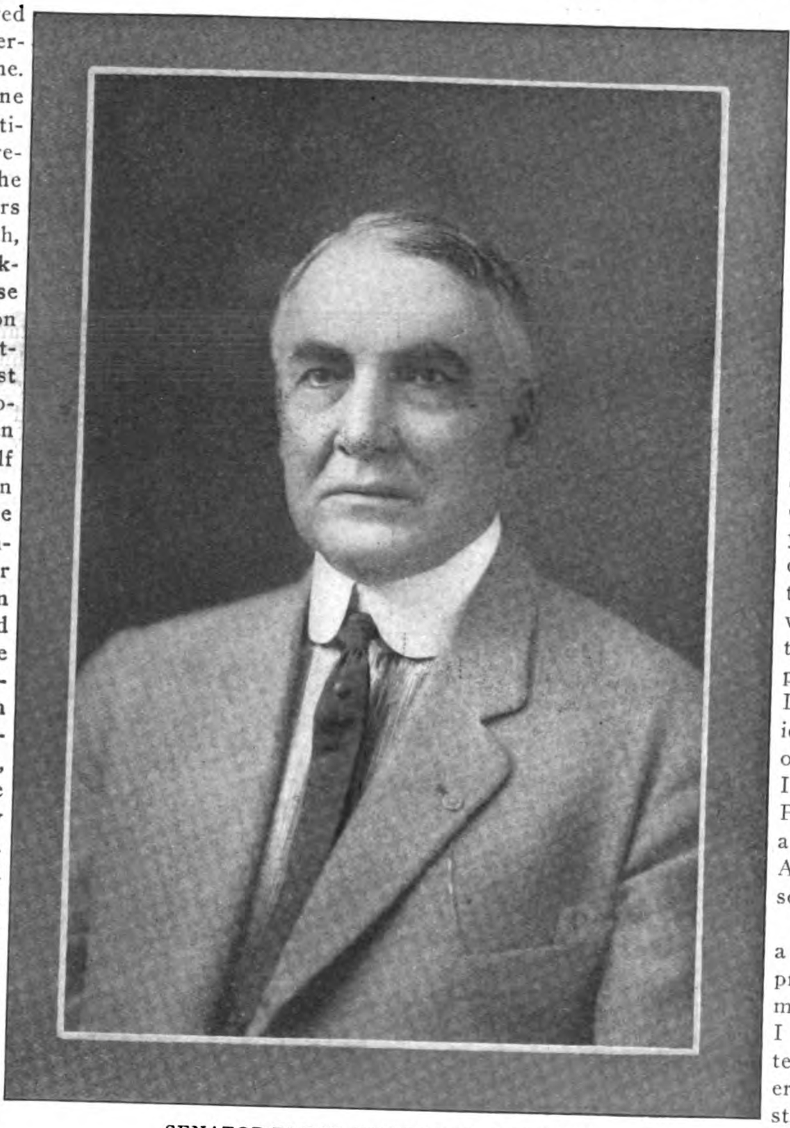
In the current issue of The Shipbuilder technical particulare are given of the new warships being completed and passed into the fighting fleets of Germany and Austria-Hungary. In capital ships alone, it is stated, Germany is now passing into service reinforcements of sufficient fighting value to justify her having contained her fleets in harbor until these new ships are available; while Austria has recently added to her fleet another battleship and scouts and destroyers of new designs—perhaps of more interest architecturally than from the strategic point of view, considering the present balance of power in the Mediterranean. Of the German ships the most important additions are the battleships of the Konig class, of which the Konig, Markgraf and Grosser Kurfurst are completed, while the Kronprinz is being pushed on with the utmost energy to enable her to join the fleet as soon as possible. Normally she would have been in her builders' hands until next July, but it is possible that she will pass into service some months earlier. The battle-cruisers Derfflinger and Lutzow, sister ships, are Germany's reply to the British Tiger class. Of the two, the former has passed into service, while the latter was launched last November and is by now, in all probability, flying the naval ensign.

E. A. Sperry, of New York, was awarded the John Scott Legacy Medal and Premium by the city of Philadelphia upon the recommendation of the Franklin Institute. Mr. Sperry has for some years worked on the problems of overcoming the numerous physical difficulties involved in the adaptation of a gyroscope to a ship's compass in the place of a magnetic needle, and has now evolved an instrument which automatically corrects for the speed and direction of a vessel and which is unaffected by the rolling of a ship in a heavy sea.

Our Merchant Marine

By Senator-Elect Warren G. Harding

I SPEAK for a restored and maintained American merchant marine. We Americans are alone in the humiliating attitude of the most resourceful nation and the most efficient producers on the face of the earth, helpless to answer beckoning markets because we are dependent upon foreign carriers. We listened to the outcry against special privilege in subsidies or subvention, an outcry that was itself subsidized by the foreign shipping interests we Americans were enriching. We failed in our preparation for our own carrying capacity, and held to our dependence instead of making for independence, and when European nations are engrossed, as they are now, and world markets are signaling the opportunity that comes once in an age, we are helpless and freshly humiliated. We could not only sell to nations at war, but more important than these, we ought and want to sell to the nations neglected by our European rivals because of war, yet here we sit, barely able to despatch our agents and we know we are unable to forward our cargoes. Though we have increased our population less than thirty-fold, we have increased our production a thousand-fold, yet our overseas carrying capacity is barely more than it was a hundred years ago. Forgetting that government aid has been the means of our marvelous development, whether it has been in agricultural co-operation or deepening rivers or harbors, whether it has been subsidized printing or mails at less than cost, we are deterred from fostering the one great essential to widened markets, namely, the means of reaching them. The pity is that the chief deterring agencies have been the foreign shipping interests which we have been paying three hundred millions a year to blind us to our own folly. No producer is equipped to achieve until he has a way to his market. That was what made inland canals and waterways invaluable before the age of steel highways. That was what made the building of a railroad an epoch-making event to the ambitious community. That is why we spend millions annually for improved roads. That's why the ox-cart gave way to the motor car. We have been surpassing in interior development and remained the gold-bricked nation on the highways of the seas. We have maintained a creditable supremacy at home, and furled our commercial flag at seas.



SENATOR-ELECT WARREN G. HARDING

The founding fathers gave us an American merchant marine which carried more than 90 per cent of our commerce across the seas. Modern lack of patriotism has given Europeans 90 per cent of our trans-oceanic trade. We abandoned our fostering policies—discriminating duties brought in American bottoms, preferential tonnage taxes, and mail subsidies—and the competing world profited by our example, growing in prestige as our glory waned. England has expended $400,000,000 in subsidies in 70 years, and it made her mistress of the commercial seas, and we expended $400,000,000 in seven years on the Panama canal and made it a gift to the shipping of the world, then repudiated the preference we had pledged to our own ships. It seems to me un-American and unheeding of our own commercial interests. I would have made the Panama canal the chief agency of increased American eminence at sea.

I do not pretend to be a specialist on this great problem of a restored merchant marine. But this I do know, that the fostering policy of the fathers, who reared new standards of freedom and started the temple of the republic amid the chaos of dearly won liberty, builded up American shipping in 20 years of righteous partiality to American interests so that it was the envy and admiration of the maritime world. Our sails whitened every sea of Occident and Orient and the stars and stripes were reflected in the azure depths of every highway of strait, gulf or ocean. What four millions of struggling Americans could do, more than 100 years ago, in the inspired beginning, one hundred millions of prosperous Americans may do still better today in the prospering march to fulfilment. We need only to be impelled by the same spirit and guided by the same policies. We must awaken to the tremendous importance of

*Speech before Youngstown Chamber of Commerce, Nov. 19.

this problem. If we are to remain blind to the need of a merchant marine as an auxiliary to our navy, which is our national defense—and I suspect we will until we learn a lesson at unspeakable cost—we ought at least be alive to the problems of trade which have to do with all the employments of peace. No nation can ever hope to triumph in the markets of the world when its carrying agents are controlled by its rivals in trade. We are helpless when they are locked in the struggle of war, and connived against in the stress of competition in peace. But we are big enough, strong enough, rich enough and capable enough to establish and maintain an American merchant marine which shall aid us in war and embark with our cargoes to all the markets of peace, and we ought to do it, and we mean to do it, even if we have to invoke the spirit of the stalwart fathers to lead us back to the rightful paths to greater American glories.

Economies of Marine Fuel*

By Prof. A. W. Kirkaldy

THE great factor today in ocean transport is fuel. Ship and engine have been greatly improved, methods of conducting the business have changed, routes have been modified, and a further modification is confidently expected with the opening of the Panama canal; but throughout all these, and above them all, dominates the commodity whence the power for driving the vessel is obtained. It is no exaggeration to say that the nations which control the resources whence motive power can be produced will in increasing measure have the opportunity of dominating the rest of the world. But incumbent on them is the necessity of so exploiting and developing their resources that they may obtain a maximum of power at a minimum of economic waste. The fuel resources of the world today consist, for the purpose here in question, of coal and oil. The countries enjoying in the greatest degree resources, either worked or unworked, are the British Empire, the United States of America, the Russian Empire, and China. Here then is a question of world-wide interest, one important section of which can be studied to advantage in considering the economies of marine fuel. The evolution of the modern marine engine is a story of consuming interests. No sooner had James Watt produced a steam-engine than attempts were made to apply steam power to ship propulsion. At first the experiments were almost grotesquely unsuccessful. But the men at work on this development were men of grit, nor could any failure daunt them in their efforts. The chief spheres of action were the west of Scotland and the north-east coast of America; with the result that both Britain and America claim the honor of having been the first to propel a water-borne craft by steam power.

Two facts, however, stand out among a great mass of controversy, and these should please the pride of both countries. In the year 1802, William Symington built and engined the Charlotte Dundas, a small craft which ran on the Forth and Clyde canal, and was proved to be efficient for both passenger and goods services. This little craft was the germ whence sprang the Clermont, built by Robert Fulton at New York in the year 1807, and the Comet, the first steamer to run regularly in European waters, built by Henry Bell on the Clyde in the year 1812. Thus Symington solved the problem of steam propulsion by the construction of the Charlotte Dundas, whilst Fulton was the first regularly to utilize the invention on any scale, for he ran the Clermont on a regular service between New York and Albany, a distance of about 130 miles, from the year 1807.

From the beginning of last century there were two great possible developments in the business of ocean transport; the substitution of iron for wood as the material for ship construction, and the improvement of the steam engine to a point at which steamers could compete on commercial lines with sailing ships for the carriage of freight. Nor were these separate problems, for really the success of either depended on a common development. The modern marine engine could not work to advantage in a wooden hull, nor is it possible to imagine an Aquitania, measuring nearly 50,000 tons, propelled otherwise than by turbine engines driving quadruple screws.

To Robert Napier, of Glasgow, belongs the credit for the revolution wrought by the compound-engine. His experiments almost immediately resulted in reducing the coal consumption of marine engines to a little more than one-third of what it had been. With a working pressure of 60 pounds to the square inch, instead of requiring 10 pounds of coal per horsepower, it was found that about 3½ pounds sufficed. Since Robert Napier's day, further inventions—triple and quadruple expansion, working at a pressure sometimes considerably over 200 pounds to the square inch, requiring only a fraction more than 1 pound of coal per horsepower per hour, have completed the victory of mechanical propulsion over sails.

Thus, today, the sailing ship is for all practical purposes a negligible quantity. The reciprocating marine engine attained its highest perfection at the beginning of the present century. Quadruple expansion engines at high pressure, and driving four propellers, reached a maximum of speed and efficiency in vessels like the Kaiser Wilhelm II. This fine vessel measures nearly 20,000 tons, and has engines indicating 45,000 horsepower. She attains a speed of nearly 24 knots on a consumption of about 700 tons of coal a day. These figures are worth noting, for when the Cunard Co. arranged with the government to build for the North Atlantic service two larger and faster steamers than anything in existence, it was seriously doubted whether it would be possible to carry out the scheme. But another possibility was by that time (1907) available. As far back as 1894, the Turbinia had been built at Newcastle-on-Tyne, and to this comparatively small craft a new type of engine had been fitted by the inventor, C. H. Parsons. These engines, known as steam turbines, included the adaptation of a very old principle, but the application was completely novel, and the invention has worked a remarkable change in marine engineering. The speed attained by the Turbinia broke all previous records, being no less than 34 knots. After many experiments in high-speed government vessels, this new type of engine was fitted to the Victorian, the Virginian, and the Carmania, all large steamers on the

*Paper read before the British Association in Australia.

North Atlantic service. It was the success of these, especially of the Carmania, owned by the Cunard company, which, after much consideration, led to the decision that the two special vessels to be constructed for the Liverpool-New York service should have turbine engines. These two fine vessels, the Lusitania, built on the Clyde, and the Mauretania, built on the Tyne, were placed on the service in the year 1907. Their achievements have outdone all previous records. The Lusitania in March, 1914, made a record day's run of 618 knots, at an average speed of nearly 26¾ knots, beating the previous record of the Mauretania, which was 614 knots for the day's run. The fuel consumption of these vessels averages about 1,000 tons per day, and the engines indicate about 70,000 horsepower. At first the turbine engine could only be fitted to vessels where speed was the great object, it being proved by experience that the greater the speed attained, the greater was the saving of fuel effected, whereas for slow-going vessels, the turbine offered no great advantages over the ordinary reciprocating engine. Experience showed that in the case of a steamer having a speed of 14 knots the running expenses of the two types of engine were equal; as, however, speed increased, the turbine showed an increasing economy, but at a speed of less than 14 knots the reverse was the case. Four years ago, however, the effects of gearing were tried, and it was found that, even for slow-going cargo vessels, the turbine, when the speed of the propeller was reduced by gearing, could be the economic rival of the reciprocating engine.

A steamer called the Vespasian was fitted with this new type of engine, and experiments now ranging over nearly four years have convinced some shipowners of the superiority, not only in economy of consumption, but in reliability, of the turbine engine for slow-speed vessels. The situation has, however, become complicated by the appearance of another rival, in the shape of the internal-combustion engine. It would appear that in this development, the attention of British engineers was so keenly focused on the relative merits of the reciprocating and turbine engines, that for a time they neglected or treated with disdain the invention of Dr. Diesel. The engineers of other countries, however, were attracted by the Diesel engine, with the result that Russia and Scandinavia are at present somewhat ahead of the United Kingdom in its application to practical commerce. Today, however, the whole engineering world is awake to the great possible advantages of an engine that requires no boilers, and consumes a minimum of fuel. Thus at the present moment the shipping community, in common with marine engineers and architects, are keenly watching the performances of rival methods of propulsion. The quadruple expansion engine still has many advocates, but it would appear that the ultimate contest, so far as cargo vessels is concerned, will be fought out between the geared turbine and the internal combustion engines.

Coaling Stations—Equipment and Supply

The first coaling stations were organized to meet the requirements of British mail and passenger steamers, and the coal supplied was the product of the collieries of the United Kingdom. This latter fact has had a great and unexpected effect on the British mercantile marine. Owing to the bountiful and easily worked supplies of iron and coal discovered in large areas of the United States, not only have the Americans become producers of both fuel and steel, but they have eclipsed all competitors in these industries, and are now producing nearly one-half of the world's supply of coal, and rather more crude steel than both the United Kingdom and Germany together. The shipbuilders and shipowners of the United Kingdom were the first to apply steam to purposes of ocean transport, and the employment of the marine engine hastened the coming of the iron and steel hull for ships. In this, again, Englishmen were the pioneer workers. Then as the steamer ousted the sailing ship in trade after trade, the importance of the British mercantile marine grew, and with it the demand for British coal. These two things acted and reacted upon each other with a marvelous effect in building up a very great commerce. English coal was purchasable at almost every seaport in Europe, Asia, and Africa, and at the many coaling stations that had been established on islands conveniently situated in mid-ocean on the main steamship routes.

The effect of this fact is of the utmost importance, and must be realized in all its bearings, for it has been a great cardinal factor, perhaps the greatest factor in modern shipping business. It is not so many years ago that English coal alone was available at the fuel stations on the principal ocean routes. But the scientist and the business man have worked together in discovering and making available the coal resources of every continent. With the opening up of other sources of fuel supply for shipping purposes, the area that can be economically supplied with English coal has experienced a gradual restriction. But although this tendency becomes accentuated, its effects are not visible to the superficial observer, because all that he notes is the increasing export of the output from the collieries of the United Kingdom. The facts of the situation are that with a restricted area demanding our coal, there has been a greatly increased demand within that area; hence the fact that certain markets demand smaller quantities, or none at all, is only known to the coal exporter and the freight market. The coaling stations on the Suez route to the Far East and to Australasia were exclusively supplied with English coal. But Australia, New Zealand, India, China, and Japan have all been steadily improving both the quantity and quality of the coal they can put on the market, and the competition is being felt throughout the Far East.

The quality of some of these coals is not equal to that of English coal, but being on the spot, and labor being cheap, the difference in price is sufficient to make in some instances the poorer quality coal rather more economical for the ordinary cargo steamer to consume. Australian coal, the best of which is said to come within 12 per cent in fuel value of Welsh, is also subject to exportation, and can compete in the various coaling stations east and south of Colombo. But for the most important developments attention must be directed to America. American coal has already made its appearance in various European markets, and some authorities predict that it will be competing with our own coal in the markets of the United Kingdom before long. When the Panama canal is open to traffic, and the American route is in full competition with the English route to the Far East, the cost of fuel will be one of the determining factors as to which route shall be followed. Nor is the advent of American coal, shipped by American ships to American stations, a pleasurable prospect for British shipping interests, for with the export of coal on a large scale, American shipping will again become a serious competitor for the ocean transport services.

M. Mitchell Davis & Son, Solomons, Md., recently completed the tug Takana for P. Sanford Ross, Inc., of Jersey City, N. J. The Takana is 78 x 18½ x 9 feet.

Cunard Liner Transylvania

In the December Issue of the Marine Review Attention Was Paid to the Geared Turbines of the Cunard Liner Transylvania, the Latest Addition to the Fleet of Cunarders. Further Particulars Have Now Been Received from the Company Regarding the Passenger Accommodation

THE public rooms include dining rooms, drawing rooms, smoking rooms, lounge and verandah cafe. Those are all large and furnished luxuriously. A gymnasium is provided fully equipped with all modern apparatus. The staterooms are of large size and fitted on the most modern plan.

The heating and ventilating of the ship has received special attention. Steam, the thermo-tank system, and electrical fans are used in addition to a very perfect arrangement for utilizing to the fullest extent the natural facilities for obtaining fresh air in all parts of the ship.

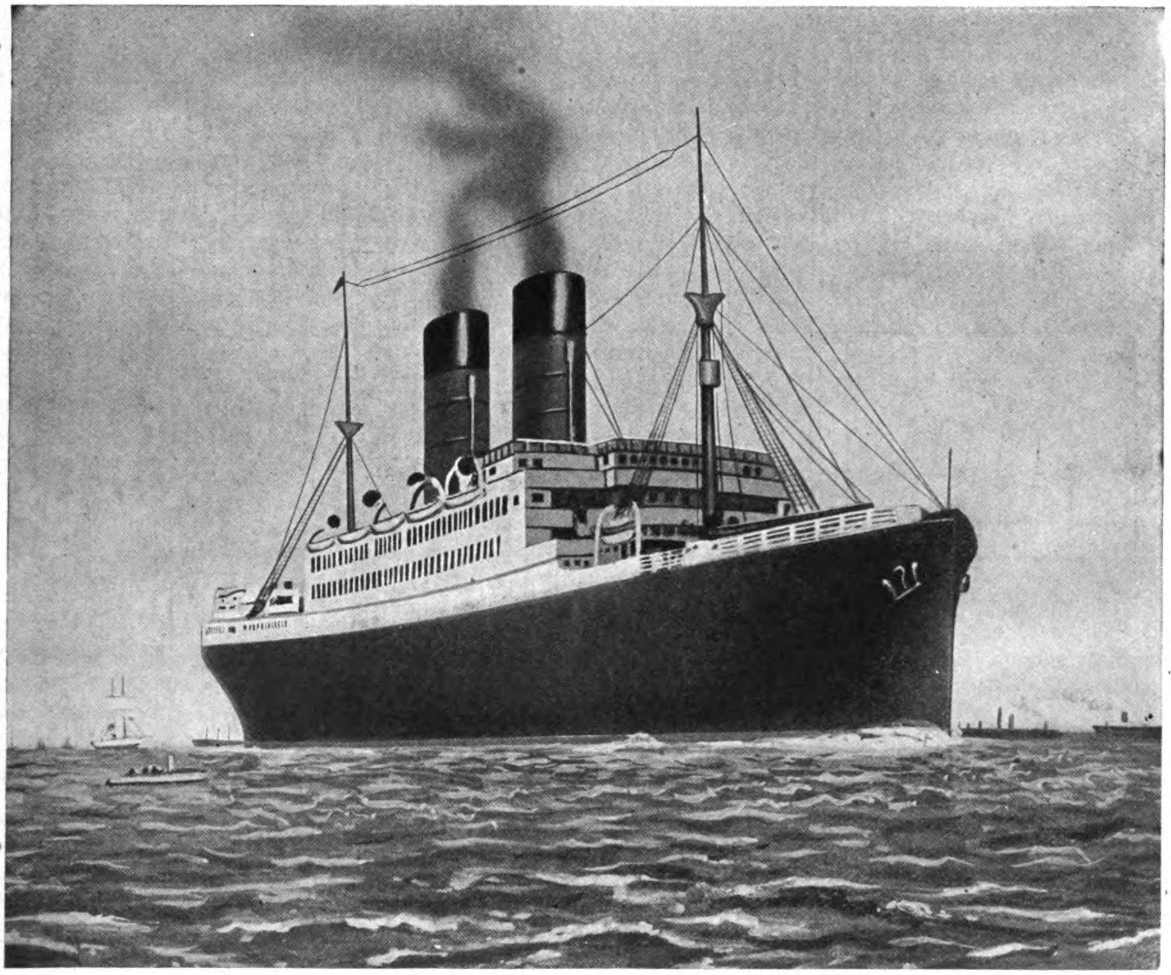
Every appliance for comfort, security and stability that modern science and the long experience of the oldest trans-Atlantic line suggested as desirable are embodied in the construction of the Transylvania, and the arrangement and equipment of the passenger accommodation represents in every detail the perfection that has been atttained in Cunard "floating hotels".

Dining Saloon

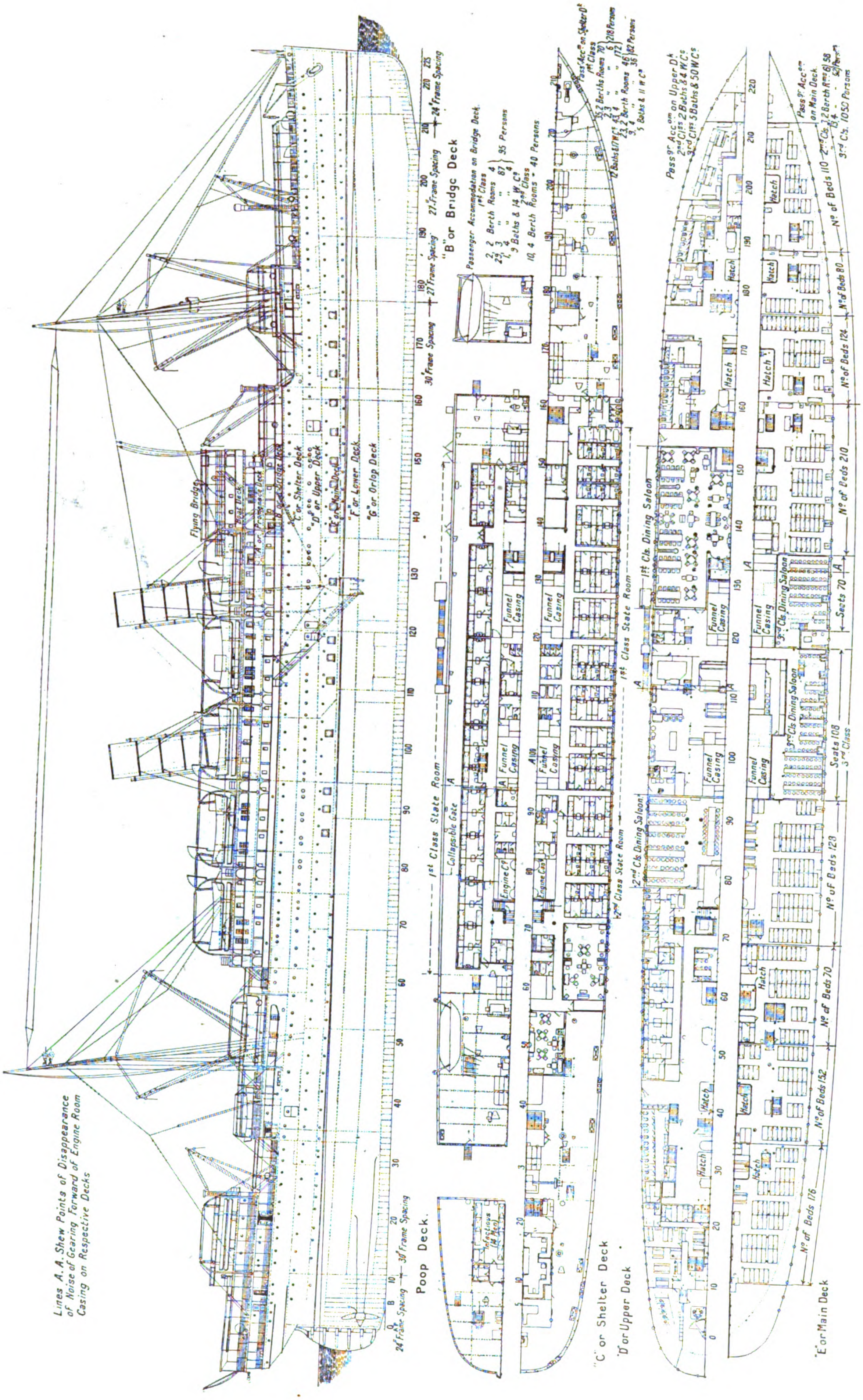
As on all Cunard steamers, the dining saloon of the Transylvania is in all respects similar to the brilliant and handsomely decorated restaurants of the best hotels on shore. There are small tables, bright with flowers, the soft light from the delicately shaded electric lamps, the pilasters with gilt caps, the dome, the gallery with its handsome balustrade, and of course, the indispensable orchestra. The paneling round the room is a delightful buff color, harmonizing with the blue curtains and the blue covering of the mahogany furniture.

The lounge is on the same deck as the drawing room and smoking room, and overlooks the wide promenade on each side of the ship. It is a particularly bright and attractive room, furnished and designed in excellent taste. Here passengers, both ladies and gentlemen, gather for coffee, etc., after dinner, or take tea with their friends during the afternoon. The paneling round the room is in olive-wood inlaid with lines of sycamore, and the floor is of polished oak. The carpet can be removed for dances that add so much to the gaity of a voyage.

If the drawing room is distinguished by its delicacy and daintiness, the outstanding features of the smoking room is its warmth of treatment. The deep



CUNARD LINER TRANSYLVANIA



DRAWINGS OF GEARED TURBINE LINER TRANSYLVANIA

walnut paneling of the walls, the wide settees, spacious armchairs, richly upholstered, convey an atmosphere of cheery contentment and luxurious comfort. The floor is laid with rubber tiling. An open fireplace and fenestrated windows hung with curtains completely eliminate all preconceived notions of a room on board ship.

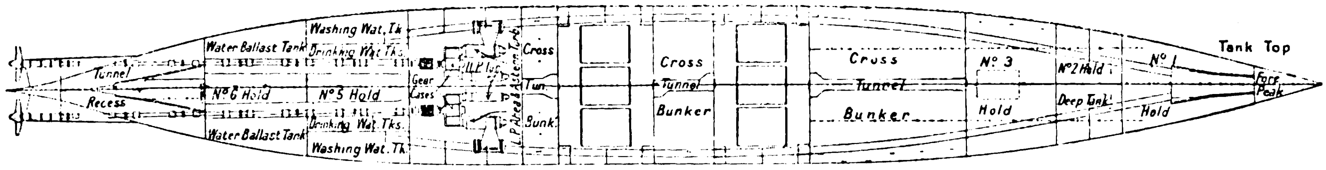
The second cabin accommodation of the Transylvania adds still further to the unrivaled reputation of the Cunard Line for luxury and comfort. A full suite of public rooms including dining saloon, smoking room and drawing room, has been set aside for the use of second cabin passengers, and, in point of decoration and furnishing, these spacious apartments are models of good taste. Comfortable armchairs, settees, library and every other auxiliary to insure the pleasure and well-being of those on board has been provided. There are ample open and covered deck promenades, and the staterooms are large, well ventilated and heated.

The installation of geared turbines, which heretofore have been applied only to smaller vessels, in a large Atlantic liner, was an experiment attracting much attention. The opinion of the technical observers of the Transylvania during her trip from Clyde to Liverpool was wholly favorable. Geared turbines not only require less engine space, but serve to propel the vessel with remarkable absence of noise and vibration, and it was declared that hereafter all vessels of any importance would be engined on this principle.

Parsons Type

The twin screws are driven by turbines of the Parsons type working through reduction gearing. The gear wheels are about 10 feet in diameter and 5 feet in breadth, each driven by two turbines working in series, and running at about 1,500 revolutions per minute. An astern turbine of the impulse reaction type is incorporated with each low pressure ahead turbine. The arrangements are such that either the high pressure turbine or the low pressure turbine can be used independently, so that the derangement of one turbine will not prevent the vessel proceeding on twin screws. A complete system of forced lubrication is installed for all turbines and gear wheel case bearings. The auxiliary machinery includes three independent electric generators, evaporators with a combined capacity of 100 tons of fresh water per day, and a large installation of refrigerating machinery. Special electrically-driven fans are fitted overhead in the engine room drawing air through trunks from the boat deck, and distributing it uniformly throughout the engine room, stores and work shop, providing excellent ventilation for the engine room, etc. A complete and independent electric lighting set for emergency purposes is fitted aft on the poop.

The boiler installation consists of six large double-ended Scotch boilers working on natural draft with a pressure of 210 pounds arranged in two groups of three each in separate boiler rooms.



BOILER AND ENGINE ROOM PLAN OF TRANSYLVANIA

Behavior of Ships in Canals*

By Victor L. Trumper

THE writer has often found captains and officers of ships astonished at the apparently erratic behavior of vessels in the Suez Canal, which refuse at times to obey either the helm or the engines. The steering qualities of a ship at any particular time depend on several causes, such as draught, trim, list, depth of water under keel, etc., the interaction of which is not thoroughly understood; but in the following article the writer will attempt to explain the general reasons why ships "sheer," and their ofttimes refusal to straighten up in spite of being nursed with helm and propeller.

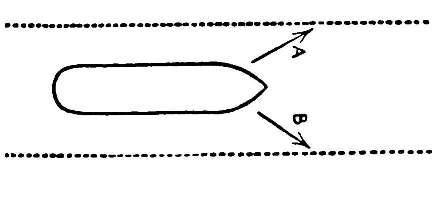


Fig. 1.

It stands to reason that if a ship is shaped absolutely symmetrically, and is being steered well along the center of a canal with perfectly even and straight sides, she will not sheer.

With the shape and symmetry of the ship, seamen have nothing to do, having to leave that to the learned gentlemen on shore, who design ships so that the helmsman cannot see over the bow, place officers' cabins (save the mark) in close proximity to winches and galleys, make lavatories that in bad weather form excellent working models of Iceland geysers, and put bridge telegraphs in such positions as will be almost sure to jamb the officers' fingers, or go a long way towards fracturing his pelvis on a dark night.

About bad steering I have little to say, as every officer is familiar with that, but, of course, it is obvious that the nearer a ship is kept to the middle of the canal, the straighter she will go. Some men steer with their heads, others simply open and shut the steam valve of the steering engine—the former are the only ones of any use in the canal.

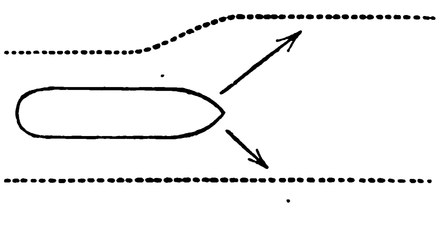


Fig. 2.

The next question is as to the bed and sides of the canal in causing sheers, and later on I shall show that bad steer-

*From the Nautical Magazine, Glasgow.

ing brings the same forces in operation that unevenness in the canal does. In the subjoined diagrams the short arrows represent *increased* water pressure, and the longer arrows relatively *decreased* water pressure, or in other

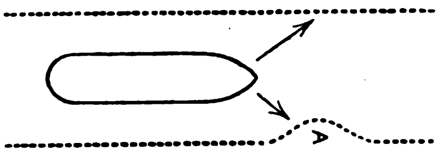


Fig. 3.

words greater facility for getting out of the way of the oncoming ship.

In Fig. 1, we see a ship going along the center of the canal; the thick lines represent the waterline of the canal, the dotted lines show the navigable channel, and, of course, betwen the dotted and thick lines the bank slopes. Now as the ship moves ahead she pushes the water away from her as represented by the arrows *A* and *B,* or conversely the water is pressing equally on both bows, and if these pressures remain relatively constant, no deviation of the ship takes place. However, when the ship gets to a siding the equilibrium is upset, see Fig. 2. The pressure on the starboard bow remains the same, but owing to the enlargement of the canal on the port side, the pressure on the port bow is considerably reduced, because the water that is being piled up by the port bow has more room to get away, not being hemmed in by the comparatively close proximity of the bank as it still is on the starboard bow. The result is that the bow is pushed away to port. It may be asked why is the whole ship not affected? But it must be remembered that the stern of the ship is still in the narrower part of the canal, and so is not affected till later, when the sheer has already taken place.

The same thing happens when there is an unevenness in the bed or sides of the canal, see Fig. 3. Suppose, for example, the bank has fallen in at *A;* then when the bow gets opposite that place, the water that is being pushed away by both bows cannot get away as freely from the starboard bow, as from the port bow, and consequently it exerts pressure which pushes the ship's head off to port, and a "sheer" results.

Hitherto, we have only considered sheers from causes outside the ship, but, of course, the same forces are at work when the ship gets near the bank through bad steering, see Fig. 4. The bow approaches the bank of the canal and piles up the water which attempts to escape in three directions, ahead, astern and under the bottom. As the ship comes up to the sloping bank the escape under the bottom is gradually cut off, till there are only two directions for the water to get away, ahead and astern. It is generally at this point that the ship's head is violently thrust away from the bank by the water pressure, and a "sheer" results. Of course, if the ship actually touches and "cannons off" the sheer is all the greater, but that cause being so obvious is outside the scope of this article.

Now the next question is, why, when the ship is once more in the middle of the canal, will she not recover herself? For seven times out of ten she will not, but runs over to the opposite bank and hits it more or less hard. There are, I think, two main causes of this non-recovery, the first and most obvious being the violence of the thrust away from the bank which her bow has received, either by water pressure, or actually touching the side as previously explained. The other main cause is less obvious, but I think none the less potent.

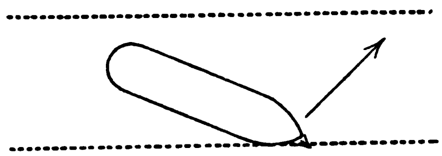


Fig. 4.

It must be remembered that although on account of a sheer a ship alters the direction of her fore and aft line, yet she still has a certain momentum in her previous direction, viz., parallel to the axis of the canal. This phenomenon is familiar to all seamen, by the dead water observed on the inside of a ship's turning circle, which represents water that she has passed bodily over in a direction different to her fore and aft line, but approximately the same as her previous course. Now let us glance at Fig. 5.

For purposes of illustration we will consider her momentum down the axis of the canal as increased water pressure on the starboard side, represented by the arrow *AB;* it will be seen that her side from the bluff of the bow to the commencement of the run aft (*CD*) presents a diagonal surface to the water pressure, but the bluff of the bow to the stem (*CE*) presents an approximately flat surface, so the water pressure acting more strongly on the flat surface, and so keeping the bow off, tends to prevent the ship righting herself.

It may be asked, why do not the same forces act in pushing her bow off the second time, as they did when she took the first sheer? But it must be remembered that approximately the ship took the first sheer from the center of the canal, and so she would "smell the bank," to use a common and expressive phrase, at a very small angle and consequently the pressure of water is exercised almost solely on the inside bow. Now when she sheers over to the other side she has time and space to alter the angle of her fore and aft line in relation to the axis of the canal more than in the first sheer, because the second sheer started from the canal side instead of the center. That being so, the water pressure as she nears the bank in the second sheer, is acting more or less on *both* bows, and so has less effect in pushing the fore end of the ship off; and what little effect it has is more than counterbalanced by the violence of the thrust her bow has received from the other side, and the water pressure due to her momentum along the axis of the canal.

In conclusion, it may be asked how to avoid sheers. But there is no cure for it other than careful steering in the center of the canal. However, there is one thing that aggravates them and that is too high a speed, for the great majority of ships steer better in narrow waters with a low speed; and it is often forgotten that it is only very slightly the "way" of a ship through the water that steers her, but principally the thrust of the water from the propeller against the rudder; for it is within the experience of all that many a ship which steers well enough when the engines are working, goes all ways when they are stopped no matter how much way she has. It is well known that water pressure increases as the square of the speed, and as sheers have been shown to be caused

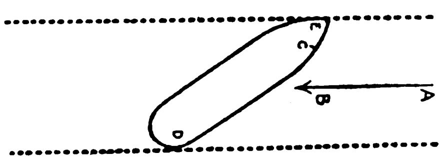


Fig. 5.

by unequal water pressures, it follows that a low speed diminishes the relative inequality of the water pressures, and makes the ship less liable to take dangerous sheers. It is the writer's opin-

ion that this was the cause of the collision between the Hawke and Olympic (always supposing the helm was not put the wrong way), for the Hawke had shoal water on her starboard side, and this would tend to make her sheer to port, which tendency would be vastly increased by her high speed at the time. I do not remember to have seen this mentioned at the trial, but I think this cause will commend itself more to practical men than the new "suction theory."

Isherwood System of Construction

Showing a Seven Frame Space Section of Transverse Framed Vessel

By Robert Curr

THIS article shows the materials in the section of the Isherwood vessel and the plans and tables are arranged in the same way as the transverse framed vessel.

Fig. 1 is the cross section with the materials contributing to the longitudinal strength. Figs. 2, 3 and 4, the expanded plating of the shell, tank top and stringer. Figs. 4, 5 and 6, the expanded plating inway of a watertight bulkhead: Fig. 4 is common to both. The rivet spacing is the same as in the transverse framed vessel: 5 and 7 diameters center to center.

The area of tank top side should read 18.73 in the transverse section making a difference in the area of 9.79 square inches. This does not make any noticeable difference in the important items. Following are the findings in both cases:

	Transverse frame.	Isherwood.
Area of materials at unavoidable weakest section, sq. in.	328.00	372.00
Area of plating at watertight bulkhead section, sq. in...	283.00	270.00
Neutral axis above keel, ft..	6.08	6.233
Tension on top sides, tons...	5.02	4.25
Compression on bottom, tons.	2.43	2.13
Bending moment	11,863	11,863
Moment of inertia..........	29,683	34,674

There are 13 square inches less material at bulkhead in the proposed section than in the section according to Lloyd's rules.

There are 57.67 square inches less at bulkhead in the proposed section than at the unavoidable weakest section of the transverse framed vessel and the value of rivets connecting the longitudinals to the bulkhead is 59.47 square inches which shows that the proposed Isherwood section is as strong at the bulkhead as the transverse framed vessel and that the bulkhead doublings can be dispensed with if the strength of Lloyd's Rules is only required.

By fitting bulkhead liners the strength at the bulkhead can be made equal to the unavoidable weakest section which is 2.288 tons stronger than the transverse framed vessel, that is considering the rivets in tension and sheer of the same value.

We are cautioned to put little de-**pendence on rivets in tension but out of all the vessels repaired on the Great Lakes we have to see the first case of weakness in the rivets referred to.**

The bulkhead frame and floor and girder on each side have been found bent and broken but the rivets connecting the girders to the bulkhead floor plate were undisturbed.

Fig. 7 shows the midship section of iron auxiliary screw clipper Annette, built on the longitudinal system practiced by Scott Russell, and described by him in May, 1862.

The principal arrangements of the system are thus stated by the author:

1. "To divide the ship by as many transverse watertight bulkheads as the

	A.	C. G.	Moments.	h.	h²	Products A x h²
Keel plate	7.44	0.03	2.23	6.20	38.44	274.46
B strake	23.17	0.15	3.48	6.08	36.96	856.36
C strake	17.16	0.15	2.58	6.08	36.96	634.43
D strake	23.60	0.30	7.08	5.95	35.40	835.44
E strake	21.03	0.45	9.47	5.78	33.40	702.40
Rider tank top..........................	4.77	3.15	.15.03	3.08	9.48	45.22
a—Strake tank top..................	21.29	3.10	66.00	3.13	9.79	207.43
b—Strake tank top..................	21.29	3.05	65.00	3.18	10.11	215.33
c—Strake tank top..................	15.23	3.67	55.90	2.46	6.05	92.14
½ Center girder	6.04	1.50	9.06	4.73	22.37	135.11
½ Center girder top	1.32	3.00	3.96	3.23	10.43	13.76
½ Center girder bottom	2.06	0.15	0.40	6.08	36.96	76.14
No. 1 channel bottom................	3.40	0.40	1.46	5.83	33.98	115.53
No. 2 channel bottom..:..............	3.40	0.45	1.63	5.78	33.40	113.56
Intercostal bottom	2.30	1.60	3.58	5.68	31.69	72.88
No. 3 channel bottom................	3.40	0.55	1.87	5.68	32.26	109.68
No. 4 channel bottom................	3.40	0.60	2.04	5.63	31.69	107.74
No. 5 channel bottom................	3.40	0.60	2.04	5.63	31.69	107.74
No. 6 channel bottom................	3.40	1.15	3.91	5.08	25.80	87.72
No. 7 channel bottom................	3.40	2.80	9.52	3.43	11.76	40.00
G strake	15.88	3.20	50.82	3.03	9.18	145.78
No. 8 channel..........................	3.40	5.20	17.68	1.03	1.06	3.60
H strake	20.60	7.00	144.20	0.77	0.59	12.15
No. 1 tank top longitudinal............	2.53	2.95	7.47	3.28	10.75	27.30
No. 2 tank top longitudinal............	2.53	2.90	7.34	3.33	11.08	28.43
No. 3 tank top longitudinal............	2.53	2.80	7.09	3.43	11.76	29.75
No. 4 tank top longitudinal...........	2.53	2.70	6.84	3.53	12.46	29.03
Tank top corner angle................	2.80	3.10	8.68	3.13	9.79	27.42
No. 5 TT longitudinal................	2.53	4.15	10.50	2.08	4.32	10.93
Tank top side d......................	16.66	5.50	91.63	0.73	0.53	8.83
No. 6 T. T. longitudinal..............	2.53	6.00	15.18	0.23	0.05	0.12
Margin	4.88	8.00	39.04	1.77	3.13	15.28
No. 9 longitudinal......................	3.40	10.40	35.36	4.17	17.38	59.10
I strake	23.17	12.10	280.36	5.87	34.45	798.20
No. 10 channel......................	3.40	12.90	43.86	6.67	44.48	157.23
No. 11 channel......................	3.40	15.50	52.70	9.27	85.93	392.16
Sheer strake	21.45	16.50	354.00	10.27	105.47	2,262.33
Stringer plate	31.35	18.50	580.00	12.27	150.55	4,719.75
Stringer angle	2.06	18.35	37.80	12.12	146.89	302.60
Stringer longitudinal No. 1............	2.53	18.15	45.92	12.12	146.89	371.63
Stringer longitudinal No. 2............	2.53	18.30	46.30	12.07	145.68	368.58
Stringer longitudinal No. 3............	2.53	18.45	46.68	12.22	149.32	377.78
Hatch coaming	6.41	19.05	122.11	12.82	164.35	1,053.48
	371.83		2,317.83			16.038.53

Neutral axis above keel $= \dfrac{2{,}317.83}{371.83} = 6.233$

$\dfrac{1}{12} \times A \times d^2 = 1{,}299.00$

$16.038.53 + 1{,}299.00 = 17{,}337.58$

Moment of I $= \dfrac{17{,}337.58}{2} =$ 34,674.16

Bending moment...... $= \dfrac{2{,}162.5 \times 192}{35} = 11{,}863$

Tension on top........ $= \dfrac{11{,}863 \times 12.42}{34.674} = 4.25$

Compression on bottom $= \dfrac{11{,}863 \times 6.23}{34{,}674} = 2.13$

*This is the nineteenth of a series of articles on the Isherwood system of construction which began in the September, 1912, issue of THE MARINE REVIEW. The first article dealt with the general specifications of the steamer; the second with the sheet, half-breadth and body plans; the third explained the method of getting the sheer; the fourth dealt with the longitudinal and transverse framing; the fifth with offsets; the sixth with the shell plating; the seventh with the shell plating expansion; the eighth with the arrangement of plates and angles forming the spar deck; the ninth with the transverses; the tenth with bulk head construction; the eleventh with the connection of longitudinal frames to the bulkheads and transverses; the twelfth showed the interior framing between the tank top and spar deck; the thirteenth showed the amount of work that can be put together in a Great Lakes ship yard in a few hours; the fourteenth showed details of riveting in shifts of butts; the fifteenth considered the subject of butt straps and laps; the sixteenth discussed Lloyds rules and their application; the seventeenth shows certain details of the transverse and longitudinal system; the eighteenth gave calculation for the neutral axis and moment of inertia for the transverse framed vessel.

practical use of the ship will admit. I like to have at least one bulkhead for every breadth of the ship in her length. In a ship eight breadths to her length, I wish to have at least eight transverse bulkheads.

2. "I have between these bulkheads, what I call partial bulkheads, or the outer rim of a complete bulkhead, with the center part omitted, so as to form a kind of continuous girder running transversely all around the ship, and not interfering with the stowage.

3. "I run from bulkhead to bulkhead, longitudinal iron beams or stringers, one along the center of every plate iron deck, mainly carried by the bulkheads and by longitudinals under it; and I believe this iron is infinitely better applied in a deck than in ribs fastened to the skin."

The following table gives an idea of the difference between the new and the old systems, and is taken from ships of the same tonnage.

Weights of iron used in the general structure:

		New system.
In the skin old system...	110 tons	110 tons
In transverse internal strengthening	130 tons	40 tons
In longitudinal strengthening	40 tons	130 tons

The terms of some of the parts are different now to what they were when the Annette was built.

It will be noticed by the midship section of the Annette longitudinals are named "webs," transverses "partial bulkheads," stringer "shelf," and ties "stringers."

The longitudinals were spaced 40 inches apart and apparently there was no attempt to treat them as a continuous member for the connection to the bulkhead consisted of seven rivets, four through the floor plate of the bulkhead and three through the ceiling plate A, Fig. 9.

The cross section being intercostal would make very costly work as well as difficult to keep fair.

The deck plating which was something new at that time, was fitted edge and edge with T iron seam straps. The T iron seam straps were turned down on the cross section at the ends, making them equal to a continuous strap.

It will be observed that the specifications of the Annette were short compared to the present day details.

In the Great Eastern a vessel of 19,000 gross tons—27 times greater than the Annette—had longitudinals of the same thickness.

Repairs to Isherwood Ships

In an early issue Mr. Curr will deal with the rapidity and cost per foot area of repairs in the Isherwood type of ship. This data will doubtless prove of great interest to naval architects, ship owners and ship builders.

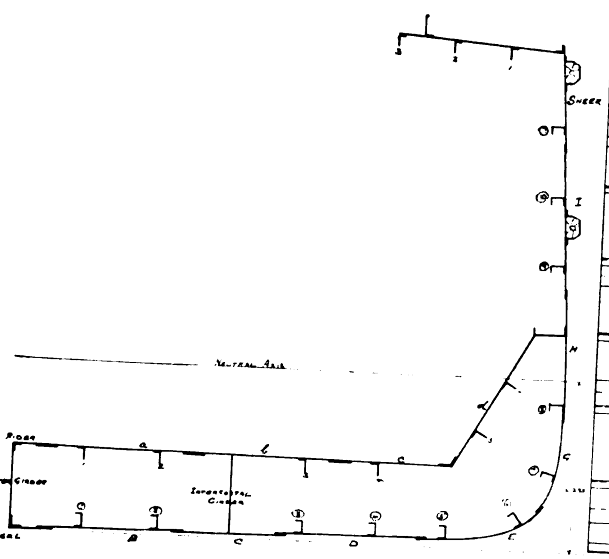


Fig. 1.

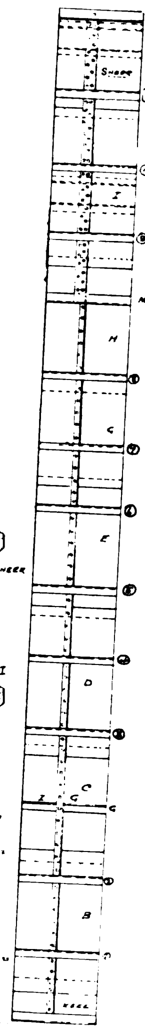


Fig. 2.

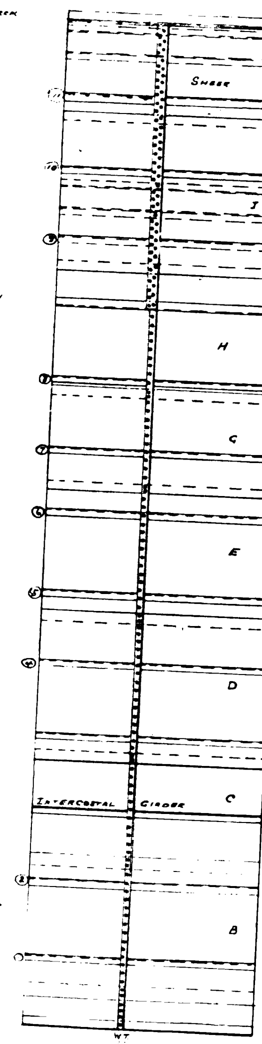


Fig. 3.

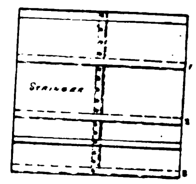


Fig. 4.

Fig. 5.

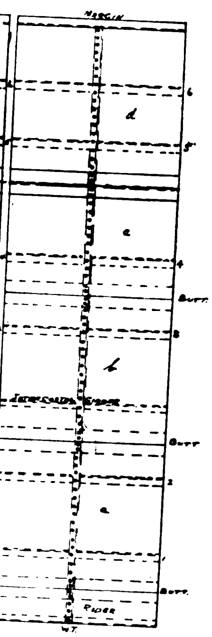


Fig. 6.

of the skin, so giving each strake of plates the continuous strength of an iron beam, one portion placed at right angles to another. This longitudinal forms one continuous scarph cross all the butt joints of the plates, hitherto their weakest part; and adds also to the strength of the rivets of the joint, the help of a line of rivets and angle-irons along the center of the plate. These longitudinals and the skin are therefore one.

4. "What remains over after this is done, of the superfluous iron formerly used in ribs, I make into a continuous

Among the advantages claimed for the longitudinal system by Mr. Russell and other shipbuilders, were the increased strength and simplicity of the bow and stern framing; the distribution of strength from the transverse bulkheads by means of the longitudinal frames, and a consequent increase in local strength generally; the support and connection of the plating of the bottom due to the longitudinal stringers on each strake crossing the butts and the rivets connecting the frames to the plating acting as joint-rivets at the weak points; the convenience for stowing

COMPARISON OF ANNETTE AS BUILT ON THE LONGITUDINAL SYSTEM WITH A SIMILAR VESSEL BUILT ON THE TRANSVERSE SYSTEM

LONGITUDINAL SYSTEM.

Length	190 ft.	0 in.
Breadth	30 ft.	0 in.
Depth at side..................	18 ft.	0 in.
Depth in hold..................	18 ft.	3 in.

SPECIFICATIONS.

Outer plating keel strake 11/16 in.
Outer plating from keel strake to upper bilge 10/16 in. and from upper to sheer strake 9/16 in. Sheer 10/16 in.
Butts of sheer strake double rivet.
Five bottom webs 18 in. deep by ½ in.
Five bottom webs bars 18 lbs. per sq. ft.
Twelve side webs 13 in. x ½ in.
Twelve side webs angles 3½ in. x 3½ in. x ½ in. and 3 in. x 3 in. x ½ in.
Iron deck, ¼ in. shelf, 30 in. x ½ in.
Bulkheads, five watertight, ¾ in. thick stiffened with 3 in. x 3 in. x ½ in. angle irons.
10 partial bulkheads, 13 ft. apart.

LONGITUDINAL SYSTEM.

Minimum Section of Metal Midship Section.

	Total.	Rivet-holes.	Effective.
Keel plate	28.29	2.40	25.89
From keel plate to upper part of bilge and sheer strake..	251.60	17.00	234.60
From upper part of bilge to sheer strake	182.40	12.00	170.40
Seventeen webs ...	221.87	19.20	202.67
Iron deck	82.80	3.50	79.30
T-irons under deck.	28.00	5.00	23.00
Deck webs	24.00	5.00	19.00
Gunwale angle-irons	8.00	2.25	5.75
Extra shelf	15.00	2.50	12.50
	841.96	68.85	773.11
Deduct for 7 butts single riveted, 2 butts double riveted, butts of iron deck single riveted			124.00
Total sq. in.....			649.11

TRANSVERSE SYSTEM.

Length	190 ft.	0 in.
Breadth	30 ft.	0 in.
Depth at side..................	18 ft.	0 in.
Depth in hold..................	17 ft.	0 in.

SPECIFICATIONS.

Keel, 7 in. x 2¾ in., garboard strake 11/16 in., longitudinal seams double riveted.
From garboard to upper bilge 10/16 in. and from upper bilge to sheer strake 9/16 in., longitudinal seams single riveted.
Sheer strake 10/16 in. upper edge and butts
Sheer strake double riveted.
Frames 4 in. x 3 in. x 7/16 in. spaced 18 in. from molding edge to molding edge.
Reverse frames 3 in. x 2¾ in. x 6/16 in.
Floors 18 in. x 9/16 in.
Deck beams, bulb irons 7 in. x 7/16 in.
Deck beams, angles double on top edge.
Center keelson, intercostal, 18 in. x 7/16 in.
Center keelson with double angle irons.
Center keelson flat plate on top 21 in. x ½ in.
Side keelsons, 12 in. x 7/16 in. with double angles.
Bilge stringer, 5 in. x 3 in. x ½ in. double angles.
Hold stringer, 5 in. x 3 in. x ½ in. double angles.
Upper deck shelf, 24 in. x 9/16 in.
Gunwale angle 5 in. x 3 in. x ½ in.
Deck stringers, two 12 in. x ½ in.
Three watertight bulkheads, ¾ in. thick stiffened with angles 3 in. x 3 in. x ½ in.

TRANSVERSE SYSTEM.

Minimum Section of Metal Midship Section.

	Total.	Rivet-holes.	Effective.
Garboard strakes	31.60	5.60	26.00
From garboard to upper part of bilge...	208.00	15.00	193.00
From upper part of bilge to sheer......	180.00	6.80	173.20
Sheer strake	52.00	2.80	49.20
Center keelson	10.13	0.75	9.38
Angle iron for keelson	13.50	1.50	12.00
Side keelsons and angles	40.50	4.50	36.00
Bilge stringers	14.00	2.25	11.75
Hold stringers	14.00	2.25	11.75
Upper deck shelf.....	27.00	0.75	26.25
Angles deck shelf....	7.00	1.25	5.75
Deck stringer	12.00	1.25	10.75
Flat plate on center keelson	10.50	1.50	9.00
	620.23	46.20	574.03
Deduct for 9 butts double riveted, calculated at 75.......			54.00
Total sq. in........			520.03

cargo, and for cleaning and painting the inside of the ship; the prevention of the wash of bilge-water with the coals, dirt and debris of every kind, which it carries with it when the ship rolls, and the consequent wearing down of the rivet heads and laps of plating; and the facilities for making the frames in place, and bending angle-irons to the easier curves required by the longitudinal system, thus effecting a saving in time, materials and workmanship.

The objection then was that there was a greater unsupported space between the frames than in the vertical system.

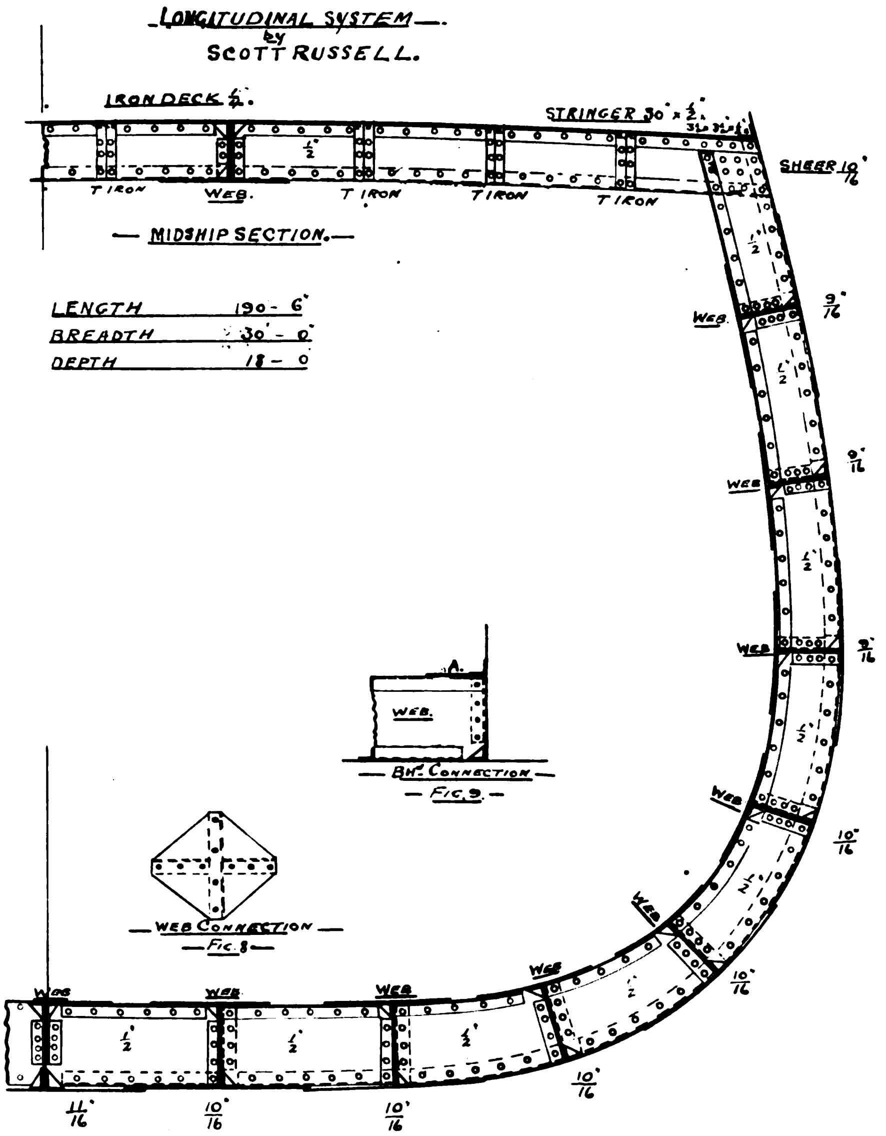


FIG. 7

The want of continuity of the cross section of the Scott Russell idea has been overcome by the introduction of the Isherwood sytsem as well as retaining the advantages obtained by that system and some more.

The eleventh annual convention of the National Rivers and Harbors Congress was held in Washington, Dec. 10 and 11.

The following bids were received by the United States engineer at Cincinnati, O., for constructing two steel deck barges for the Kentucky river: Item 1—Two steel barges delivered at Carrollton, Ky.; 2—Two delivered at shipyard: Jones & Laughlin Steel Co., Pittsburgh, Pa., item 1, $5,167; 2, $4,887; Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa., item 1, $5,700; 2, $5,300; Hartmann Greiling Co., Green Bay, Wis., item 1, $6,875; 2, $5,840; Dubuque Boat & Boiler Works, Dubuque, Ia., item 1, $6,560; Charles Hegewald Co., New Albany, Ind., item 1, $5,998; 2, $5,948; Edward J. Howard, Jeffersonville, Ind., item 1, $5773; 2, $5,673; J. K. Petty & Co., Philadelphia, Pa., item 1, $9,875; American Bridge Co., Cincinnati, O., item 1, $4,850; 2, $4,725.

Andrew Mills & Sons, 53 South street, New York, manufacturers of sails, flags and canvas work of every description, have opened an office at 421 Atlantic avenue, Boston, Mass.

Safety of Life at Sea*

In Order to Give Effect to the Proceedings of the International Conference at London a Staff of Naval Architects Will Have to be Created to Work With the Department of Commerce

By Eugene Tyler Chamberlain

EUGENE TYLER CHAMBERLAIN,
Commissioner of Navigation

THE International Conference on Safety of Life at Sea assembled at London on Nov. 12, 1913, and ended its labors on Jan. 20, 1914, when accredited representatives of the thirteen principal powers signed the most comprehensive international agreement relating to the merchant marine which has ever been effected. Even the casual student of the history of American diplomacy will find satisfaction in the attainment of an agreement which so fully accords with the principles of benevolence, freedom and reciprocity enunciated in respect of maritime commerce by Benjamin Franklin and other fathers of the republic and since consistently followed, with but slight deviations through temporary causes, as the permanent maritime policy of the United States. To American commerce and industry such an international agreement is of large and direct value. During this summer all forms of gainful occupation in America have had brought home to them the measure of their independence, hitherto unappreciated, upon the freedom of ocean transportation.

Shock of War

What the shock of war, temporarily shutting up in harbors the ships which conduct our international exchanges, has done on a vast scale, in a lesser degree conflicting maritime regulations by different nations also effect in delay and obstruction to commerce. Every year, under normal conditions, two million passengers, in round numbers, cross the Atlantic between the United States and Europe, much more than half of whom are either our own citizens or those who come to make our country their permanent home. Measures, accordingly, such as the conference incorporated into the International convention on Safety of Life at Sea, intimately affect the peace and happiness of homes throughout the United States. The London Conference and its conclusions are of special interest to the Society of Naval Architects and Marine Engineers. The influence which the United States exerted in shaping the conclusions of the conference was due in a large measure to the helpful co-operation of the Society of Naval Architects and Marine Engineers in the work of preparing in this country for the conference and to the active work of six of its members who constituted a majority of the American delegation. The more difficult subjects treated in the convention relate directly to the technical work of many members of the society, and these, I understand, will be discussed in other papers at the annual meeting. In the order of their signature to the convention, which was executed in the French language, Germany, Austria-Hungary, Belgium, Denmark, Spain, the United States, France, Great Britain, Italy, Norway, the Netherlands, Russia and Sweden participated in the conference. Before the conference was called, the United States and Germany united in the request to the British government that the Australian Commonwealth, the Dominion of Canada, and New Zealand be invited to attend the conference as self-governing British dominions, with independent delegations. Accordingly, fifteen delegations enjoyed plenary powers, while Norway's delegation was sent *ad referendum*. Japan, which had been unable to make the necessary preliminary studies, was represented from the Embassy staff at London for purposes of observation and study. The conference consisted of ninety-six delegates and technical advisers with eighteen secretaries, some of whom gave the benefit of technical training and long experience to their delegations.

It was evident at the outset that so large an assemblage could not discuss in detail the many and intricate questions on the programme, and, accordingly, the work was divided among six committees under the heads, respectively, of Safety of Navigation, Construction, Certificates, Radiotelegraphy, Lifesaving Appliances, and Revision, each nation being represented on each committee by one or more delegates. Chief Constructor, Washington Lee Capps, U. S. N., was chairman of the important Committee on Construction. A seventh committee was organized informally, comprising Lord Mersey, president of the conference, the chairman

*Read at the meeting of the Society of Naval Architects and Marine Engineers, New York, Dec. 10, 1914.

of the six committees, and two or three other members, to determine questions of jurisdiction between the committees, to consider matters not properly within the province of any committee and in general, to act as a steering committee. These committees held one hundred and thirty-three meetings during the seven weeks of unremitting work of the conference. Besides these meetings, the delegations of each nation, of course, held separate meetings for the purpose of determining the policy of each delegation as questions arose on which the delegations had not reached conclusions before the conference assembled. In many instances, of course, delegations modified conclusions in order to promote ultimate agreement.

In respect of preparation before the conference, the British, French, and German delegations were better equipped than the delegation from any other nation. The governments of these three countries more than a year before the conference met had provided ample means and facilities for the study of the more important subjects by committees of men of the highest training, and each of these delegations entered the conference with more less matured views as to the policy to be pursued on larger questions. An effort, undertaken three times, to secure from Congress sanction and means for similar preparation in the United States, was not successful. It was necessary, therefore, to organize in this country committees composed entirely of officers in the various departments more or less directly concerned with the administration of laws upon the subjects to be taken up at the conference. In this work the Society of Naval Architects and Marine Engineers was invited to help, and it may be stated here that should the convention be ratified by the senate of the United States, the co-operation of the society will be needed in the framing of laws to give effect to the convention.

The foundation of the International convention on Safety of Life at Sea is the safety certificate and the international attributes bestowed upon it. By this certificate the nation which issues it certifies that after inspection and survey the vessel which carries it complies in an efficient manner with the requirements of the convention. In every case the government which issues the safety certificate is bound by the convention fully to guarantee the completeness and efficiency of the inspection and survey. Articles 60 and 61 of the convention read as follows:—

"Article 60.

"The safety certificate issued under the authority of a contracting state shall be accepted by the governments of the other contracting states for all purposes covered by this convention. It shall be regarded by the governments of the other contracting states as having the same force as the certificates issued by them to their own vessels.

"Article 61

"Every vessel holding a safety certificate issued by the officers of the contracting state to which it belongs, or by persons duly authorized by that state, is subject in the ports of the other contracting states to control by officers duly authorized by their governments in so far as this control is directed towards verifying that there is on board a valid safety certificate, and, if necessary, that the conditions of the vessel's seaworthiness correspond substantially with the particulars of that certificate; that is to say, so that the vessel can proceed to sea without danger to the passengers and the crew."

To appreciate the great benefit to international commerce by sea and to shipbuilding and shipowning which these two articles will confer it must be borne in mind that hitherto there have been no rules of the law of nations for the safety of ocean travel. The aim of the London conference above all else was to demonstrate the willingness and ability of nations to agree upon standards of safety for ocean travel, then of their willingness to recognize the good faith of one another in agreeing to live up to those standards. This aim was attained in the two articles just quoted, and the balance of the work of the conference related to detail, important in many respects, but necessarily incomplete. The step taken is a long advance in substance and principle over the practice of the past fifty years of enforcing uniform rules for preventing collisions at sea, and it begins an era in maritime affairs.

The agreement upon the two articles mentioned was not reached without patient effort, and involved, of course, concessions. The shaping of article 61 was approached from two quite different points of view. By common consent, freedom on the open sea and the fact that vessels on the open sea remain under the authority of the flag state exclude as a rule the exercise of any state's authority over foreign vessels at sea with certain exceptions, usually made in time of war. The extent to which this principle of the law of flag should be carried when it comes into contact with the law of the foreign port in which a vessel may find itself, was the subject of contention. The United States, from the time of Chief Justice Marshall, has strongly asserted the supremacy of the law of the port. The simplest statement of this principle is found in Wildenhus's case (120 U. S., 11, 12):—

> It is part of the law of civilized nations that when a merchant vessel of one country enters the ports of another for the purpose of trade, it subjects itself to the law of the place to which it goes, *unless by treaty or otherwise the two countries have come to some different understanding or agreement.*

The British maritime policy in this respect is the same and years ago was carried so far as to evoke protest from the American government. Continental nations, on the other hand, and especially Germany since 1870, have been disposed to emphasize the law of the flag (*droit du pavillon*) and to minimize the importance of the law of the port. The German contention at the London conference was fortified by a presentation of the thorough system of inspection laws enforced on German merchant vessels, to which foreign vessels are not subject in German ports. The system of state workingmen's insurance against accidents and death, which obtains throughout Germany, is applied to her seamen on merchant vessels. Accordingly, a strong and direct pecuniary interest in the safety of German ships, their crews, passengers, and cargoes has been created among shipbuilders, shipowners, officers, and seamen quite apart from statutory requirements as to safety such as are imposed, for example, by the laws of the United States and the United Kingdom.

Law of the Flag

Article 61, it will be noted, strives to find common ground for both principles. It recognizes the principle of the law of the flag in so far as the article limits the inspection by the authorities of the foreign port to verification of the conditions set forth in the national certificate of safety. It recognizes the principle of the law of the port in so far as it enables the local authorities to assure themselves that the conditions making for safety on the vessel remain in fact such as they were certified to be by the national certificate. The law of the flag and the law of the port become identical in fact through the safety certificate. By consent of the conference, this subject was referred to the American and German delegations for solution, and article 61, which probably received more critical study than any other one article of the convention, was accepted without dissent as a just solution.

In supporting this article the American delegation was sustained by a long

line of treaties and conventions entered into between the United States and nations with which they have commercial intercourse, the purpose of which is to secure to commerce the undoubted benefits which result from abstinence on the part of the local government from interference with the discipline and internal conditions of the foreign ship. To be sure, most of these treaties and conventions were entered into at a time when the American flag was frequently seen on merchant vessels in foreign ports, but the principle maintained by the United States has not lost its value to international trade because the element of self-interest on our part has grown less. Even now its assertion, especially in ports of the republics to the south of us, is sometimes necessary. Furthermore, only eight years ago Congress passed a law (Act of March 17, 1906) providing that foreign passenger steamers in American ports shall be subject to no other inspection than is necessary to satisfy our inspection force that the condition of the vessel, her boilers and lifesaving equipments are as stated in her foreign certificate of inspection, that certificate being based on foreign requirements deemed equivalent to our own.

Establishment of International Standard

Articles 60 and 61 seem to me of especial interest to the Society of Naval Architects and Marine Engineers. The establishment of international standards of safety, coupled with the obligation upon each nation to guarantee that its own ships comply fully with the requirements of such standards, offers both positive and negative advantages to the successful prosecution of their work by a body of trained men such as compose the society. The London convention furnishes an impetus to high grade construction work in that it secures for such work international recognition. More than mere formality is intended by article 64 of the convention, by which the governments of the maritime powers agree to communicate to one another "all information which they possess affecting safety of life of those of their vessels which are subject to the rules of the convention, provided always that such information is not of a confidential nature." This article was intended to mean that the best results of the best thought of ship and engine builders shall be exchanged between nations for critical study with a view to their incorporation, if practicable, into the rules fixing international standards of construction, and to facilitate this result the convention in Article 74 provides "the governments may, through the diplomatic channel, introduce into this convention, by common consent and at any time, improvements which may be judged useful or necessary."

Again, the due performance of the obligations imposed upon nations by the convention will involve more intimate co-operation than in the past between the Department of Commerce, which is especially charged with the administration of laws relating to the merchant marine and the Society of Naval Architects and Marine Engineers. Casual study of the twelve articles on construction, comprising Chapter IV of the convention, and the accompanying nine pages of regulations, will convince any reader that a small staff of well-trained naval architects must be created to work in or with the Department of Commerce, if the United States is to give effect to the convention. Such a staff the British Board of Trade (which, of course, is a department of government, and not a board of trade as the words are used in this country) already possesses, and, through the operations of the Seeberufsgenossenschaft, Germany also obtains the best technical advice. How this co-operation is to be brought about and how this staff is to be organized are questions which may be reserved until the convention has been ratified by the senate of the United States. It is not, however, too early for the Society of Naval Architects and Marine Engineers to begin to think about the matter.

The negative advantages of the establishment of international standards will readily recur to anyone who has had occasion to observe the multitude of projects relating to the mercantile marine which spring up within and outside of Congress after any great event centering public interest on maritime affairs such as the loss of the S. S. Titanic or the brief cessation of ocean transportation upon the several declarations of war in early August. We owe to the press and to electrical communication a heavy debt for prompt and wise dissemination of knowledge on any subject at any time, but the rapidity of communication in these days gives to immature or superficial projects, based often only on the desire for notoriety, a dangerous currency not possible in stage-coach days. Of course, these observations apply to the other countries as well as to our own, for the files of the British Board of Trade following the loss of the S. S. Titanic contain quite as many and quite as foolish suggestions as those to be found in the department records at Washington. The steadying effect of international standards on subjects relating to safety of life at sea is insurance against thoughtless or harmful suggestions of legislation or regulation and attempts to pervert public sentiment to the attainment of selfish ends.

The limits of this paper and of my technical knowledge forbid a general review of the provisions of the convention. Usually they are stated so clearly in the seventy pages of the document that review is unnecessary. It is worth noting, however, that instead of the tonnage rule or the passenger rule for lifeboats the convention adopts the safe and sane rule that as the length of the vessel is the principal factor in determining the number of davits which may be erected and as the number of davits determines the number of lifeboats which may be launched promptly, the lifeboat capacity shall be fixed in relation to the vessel's length. Of course, lifeboats in excess of the total number of persons on board are not required in any event. The convention rules, if applied to the 5,647 transatlantic voyages of passenger ships between the United States and Europe during 1912 and 1913, would have provided lifeboats for all on board except in 392 cases, and in many of these the operation of other provisions of the convention would have brought passengers lists within the lifeboat rules.

The provisions in Articles 33 and 34 for a continuous wireless watch on all vessels equipped with radio apparatus, together with the requirement in Art. 37 binding the master of every vessel to proceed to the assistance of a vessel in distress, constitute the broadest declaration ever made by maritime nations in statutory form of the principle of the mutual obligation of those at sea to aid one another when in distress. In the case of cargo boats or small passenger vessels doing little commercial wireless business one operator evidently would suffice to send out distress calls in event of casualty imperiling those on board. The second operator or watcher in the case of such vessels, however, is prescribed in the interest of safety of those on board other vessels and is thus, in effect, a tax upon the owners of such vessels to insure the general safety of ocean navigation.

Mechanically Propelled Vessels

The convention applies to mechanically propelled ocean vessels (steam, motor and internal-combustion engines) which carry more than twelve passengers, in foreign trade between the nations which ratify the convention. Each nation, of course, reserves its coasting trade for its own legislation. Each nation is at liberty to exempt from the rules of the convention vessels which go less than two hundred

miles from the nearest coast. This exemption was drawn principally to cover the trade across the channel between Great Britain and the Continent, which from Brest to river Elbe, has been described as "home trade" for many years in British laws. It would, of course, cover trade on the Baltic and on the Mediterranean if the nations with coasts on those seas deem it wise to exempt those trades. Trade on our Great Lakes is, of course, reserved from the operations of the convention.

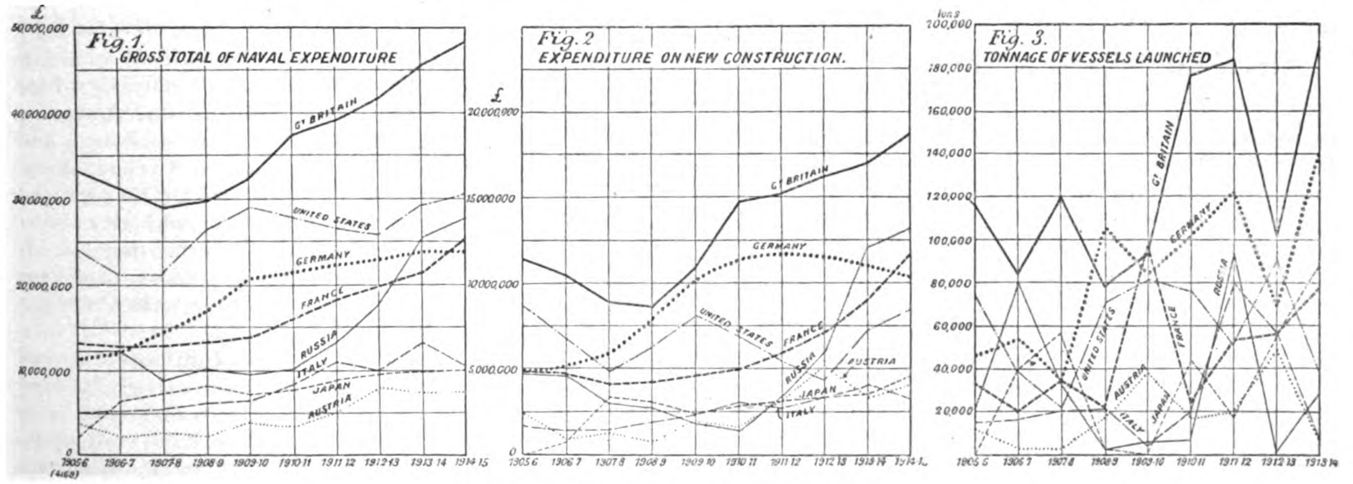
The American delegation at the outset favored the preparation of a convention which should also apply to freight steamers. It soon became evident, however, that to draft the different rules required for freight steamers would unduly prolong the conference, and would also so overload the conference that much less satisfactory conclusions as to passenger steamers could be reached. The difficulty was particularly serious in the matter of hull construction, where the problems connected with cargo are somewhat different from those connected with passenger steamers.

Ratified by European Powers

The convention was to have been ratified not later than December 31, 1914, and was to have taken effect July 1, 1915. At the outbreak of the European war, good progress had been made toward ratification. The convention was ratified by the German Reichstag in May, and its promulgation awaited only agreemment upon the schedule of exempted voyages. In Great Britain the bill to carry out the convention was laid before Parliament in May and according to programme was enacted Aug. 10, 1914, shortly after the passage of the Home Rule Bill for Ireland. The bill to give the convention effect in France was laid before the Chamber of Deputies in February and, while its consideration was somewhat delayed by the general elections in France, its passage was expected in the autumn. The Spanish government also was confident that the treaty would be ratified and the necessary legislation enacted as soon as the Cortes meets in the autumn. The bill to give effect to the treaty was laid before the Parliament of The Netherlands in the early summer and its enactment in September was expected. The ratification of the convention by Belgium and Italy, and the passage of bills to give effect to its provisions introduced in the spring, were expected in November. Austria, late in the spring, had expressed its readiness to ratify the convention at any time, but its action was dependent somewhat upon that of Hungary, where it had not yet been decided whether approval by the Hungarian Parliament was necessary in advance of the royal signature. As the Danish Parliament does not meet until 1915, the Danish government was granted a special delay by the Protocol of the convention itself until April 1, 1915. Sweden, too, could not act until the Rigsdag assembles in 1915, as the money appropriation for the ice patrol must have legislative approval. I am not advised as to the progress of the convention in Norway and Russia. The Senate Committee on Foreign Relations of the United States Senate was prepared to report the convention for the consideration of the Senate on June 10, but as the form of ratification agreed to presented some difficulties it was reserved for further consideration. The situation, of course, has been entirely changed by the events of August. Undoubtely it will be necessary to extend by common consent beyond Dec. 31, 1914, the period for the exchange of ratifications, and beyond July 1, 1915, the date when the convention shall go into effect. The duty of the United States to give cordial approval to the International Convention and the opportunity as the one great neutral nation promptly to do so have joined.

Expenditure of Naval Powers

THE annual parliamentary return showing the naval expenditure of each of the eight principal naval powers—Great Britain, France, Russia, Germany, Italy, Austria-Hungary, the United States and Japan are now available. This return gives in tabular form information regarding the navy estimates and construction of the various powers between 1905-6 and 1914-15. It is pointed out that in the case of Britain the naval expenditure includes pensions and other items which are not charged to the navy votes of other principal powers, and that for direct comparison it is necessary to deduct such figures from the British totals. In Table I we give the British expenditure less such items as pensions, etc.; in the case of other powers small items have been added when corresponding items are charged to our navy vote. The figures given in Table I are therefore directly comparable. The figures in this table are set out in curves in the diagram, Fig. 1, and this shows the position and the increasing naval expenditure at a glance.



NAVAL EXPENDITURE OF THE POWERS

In Table II there is recorded the expenditure on new construction in the various years, as taken from the statistical abstracts now issued by the government. These figures are plotted in curves in Fig. 2.

The third table shows the tonnage, when completed, of the vessels launched in each of the financial years by the respective powers. This necessarily fluctuates, as is shown in the diagram, Fig. 3.

TABLE I.—GROSS TOTAL OF NAVAL EXPENDITURE.

Year.	Great Britain.*	Germany.	France.	Russia.	Japan.	Austria.	Italy.	United States.
1905-6	33,387,568	11.472,715	13,224,364	12,392,684	2,388,018	3,838 975	5,040,000	24,444,948
1906-7	31,110,688	12,223,089	12,846,771	12.490,444	6,311,420	2,398,223	5,322.154	21,358,199
1907-8	29,119,929	14.511,863	13,099,549	8,850,240	7,371.777	2,713 540	5,661,822	21,260,732
1908-9	29,847,582	16,861,803	13,440,357	10.222,733	8,258,082	2,477,671	6,266.193	26,438,434
1909-10	32,323,255	20.522,959	14,054,063	9,650,167	7,346,879	4.068 333	6,537,118	28,990,592
1910-11	37,296,340	21,388,357	15,761.511	10,227,604	7,729,968	3,545,727	8,341.766	27,848,111
1911-12	39,165,611	22.261.732	18,209,298	13,296,370	8,861,829	5.152 382	10,832,047†	26,569,606
1912-13	41,559,318	22,907,207	19,894.468	17,681.213	9,533,997	7,867.644	10,054.505	25.902,577
1913-14	45,510,836	23,742.687	21,317,634	25,392,784	9,938,433	7,332.703	13,333,762	29,482,991
1914-15	48,113,203	23,740,349	25,412.685	27,769,294	10,023,919	7,408,196	10,313,009	30,331,364

*The figures for Great Britain exclude pensions and other items not charged to the navy expenditure of other powers.
†Includes £2,320,000 for war expenses.

TABLE II.—EXPENDITURE ON NEW CONSTRUCTION.

Year.	Great Britain.	Germany.	France.	Russia.	Japan.	Austria.	Italy.	United States.
1905-6	11,368,744	4.720 206	4,705,295	4,576,370	....	2,371,916	1,714,556	8,683.000
1906-7	10,486,397	5,167,319	4,652.010	4,576,583	767.647	1,012,499	1.362,207	6,776,086
1907-8	8,849,589	5,910,959	4,138.967	2,846,268	3,297,964	1,186,667	1,398,111	4,872,888
1908-9	8,521,930	7,795.499	4,193,544	2,703,721	3,027,276	716,662	1.866,358	6,227,874
1909-10	11,076,551	10,177,062	4,517,766	1,758,487	2,392,483	1,908,331	2,190 707	7,976,897
1910-11	14,755,289	11,392 856	4,977,682	1,424,013	2 748,349	1,583.333	2,981,200	6,889,005
1911-12	15,148,171	11,710,859	5,876.659	3,216,396	2,997,493	3,125,000	2,677.302	5,343,789
1912-13	16,132,558	11,491.187	7,114,876	6,897,580	3.289,797	5,114 206	3,227,000	4,226,728
1913-14	16,883,875	11,010,883	8,893,064	12,082,516	3,550,721	3,288,937	3,933.000	7,258,953
1914-15	18,676,080	10,316 264	11,772,862	13,098,613	4,623,919	4,051,976	3,237,000	8,443,796

TABLE III.—TONNAGE, WHEN COMPLETED, OF VESSELS LAUNCHED.

Year.	Great Britain.	Germany.	France.	Russia.	Japan.	Austria.	Italy.	United States.
1905-6	116,570	45,729	31,381	20,416	....	11.021	14,555	74,000
1906-7	83,260	53,180	19,338	80,860	39,870	2,233	16,016	37,283
1907-8	119,937	33.985	33,602	31,461	56,450	2,364	19,510	20,633
1908-9	77,202	104,971*	21,205	1,834	1 620	16,034	21,021	69,341
1909-10	92,957	83,184*	96,308	4,371	....	37,122	2,404	80,822
1910-11	176,582	101,830*	21,860	6,130	43,900	16,384	19,642	75,935
1911-12	183,283	123 130*	53,125	93,710	16,800	20 010	80.289	51,542
1912-13	113,058	69,400*	55,776	914	55,081	49,269	57,051	91,477
1913-14	189,740	139,865*	78,313	29,899	85,600	6,543	6,927	36,472

*The tonnage of German ships since 1908 does not include submarine boats.

New Steamboat Inspection Rules

During the present year the Steamboat Inspection Service has adopted new rules and amended old ones that are of interest to steamship owners and navigators. The list follows:

"Catamaran metallic cylinder life rafts of approved construction shall be allowed for each person allowed to be carried a rating of 3 cubic feet of air space for steamers navigating the waters of lakes, bays and sounds."

This amendment reduces the air space from 3½ to 3 feet.

"There shall be allowed for each person carried not less than 3 cubic feet of air space, and a deck area of not less than 4 square feet."

This amendment increases the air space from 2½ to 3 cubic feet.

The provision requiring life boats on vessels carrying passengers was amended to require

"That on all steamers over 1,000 gross tons, covered tubs, boxes or reels shall be provided in which to stow away the boat davit falls."

A rule was adopted requiring message cases to be carried on vessels not equipped with wireless, as follows:

"Whenever it appears to the licensed officers of steamers of over 100 gross tons not equipped with wireless telegraphy navigating the Great Lakes that the vessel is in imminent danger of being lost under conditions that there is a possibility of the facts in the case or cause of the loss being unknown, it shall be the duty of the licensed officers in charge to cause to be prepared a report stating the cause of the loss of the vessel and giving the facts connected therewith as fully as possible; also a list of the officers and crew, the same to be enclosed in a message case or receptacle to be carried for that purpose, in order that the facts in connection with the loss may eventually become known to the officers of this service."

Section 4417 was amended to incorporate the following rule regarding hull inspection of vessels over 15 years old.

"Every vessel whose hull is constructed of iron or steel plates shall, at the first dry-docking after said vessel has reached the age of 15 years, be thoroughly examined and inspected by the inspector for the purpose of determining the condition of the plates in the hull. The inspector shall require any such plates to be drilled that, in his opinion, require drilling to determine their condition, and should any such plates after being drilled show a deterioration equal to 25 per cent of their original thickness, they shall be removed and replaced by similar plates of a thickness equal to the original plates. This rule shall not interfere with the authority of the inspectors to drill any hull plate that has become deteriorated on any vessel of any age whenever in their judgment such drilling is necessary."

All ferry boats are now required to be equipped with a life preserver. The rule now reads as follows:

"All ferry boats shall be equipped with a life preserver where the same is allowed by law for each person carried on such ferry boat, and such life preservers or floats shall be distributed in the most accessible places, where they can be reached at all times, and it shall be the duty of the local inspectors to see that all the life preservers or floats are marked with the name of the vessel having the same on board."

The rule of most importance to bulk freighters on the Great Lakes is the one requiring storm shutters on the doors and windows on the deck house located on the main or spar deck. This rule reads as follows:

"Steamers navigating the waters of the Great Lakes, so constructed as having deckhouses on the main or spar decks and exposed to the sea, shall be provided with storm shutters for the windows, and where the doors of such deckhouses are not constructed of steel or iron plate, or of wood, having a thickness of not less than 2 inches, the doors shall be provided with storm doors or shutters: Provided, that where the boilerhouse is located on the main or spar deck and exposed to the sea, an avenue of escape shall be provided up through the top of the boilerhouse with the necessary ladders and scuttle, thereby enabling the boilerhouse doors to be kept closed during heavy weather." (Secs. 4405, 4417, R. S.)

The rule requiring fitting of storm oil tanks on all vessels over 200 tons on the Great Lakes, reads:

"On and after Aug. 1, 1914, all steam vessels of over 200 gross tons navigating the waters of the Great Lakes (except rivers) shall be equipped with oil tanks fitted with suitable hose or pipes for distributing oil overboard whenever weather conditions make the same necessary.

"Steamers of over 200 and not over 1,000 gross tons shall be provided

with two oil tanks of at least 10 gallons capacity each.

"Steamers of over 1,000 and not over 3,000 gross tons shall be provided with two oil tanks of at least 15 gallons capacity each.

"Steamers of over 3,000 and not over 5,000 gross tons shall be provided with two oil tanks with at least 20 gallons capacity each.

"Steamers of over 5,000 gross tons shall be provided with two oil tanks of at least 25 gallons capacity each.

"On steamers where the space and arrangements will permit the two oil tanks shall be in a protected place in the forward part of the vessel. However, if space does not permit both oil tanks to be placed in the forward part of the vessel, one of the required oil tanks may be placed in the after part of the vessel.

"Tanks shall be kept in a good condition and filled with animal or storm oil, ready for use when vessel is being navigated: Provided, however, that passenger and excursion steamers navigating during the interval from May 1 to Sept. 1 in any one year are not required to be equipped with oil tanks as specified in this section: Provided, further, that ferry steamers confined to the ferry routes specified in their certificates of inspection are not required to be equipped with oil tanks as specified in this section." (Sec. 4405, R. S.)

Death of Admiral Mahan

Rear Admiral Alfred Thayer Mahan, American foremost naval strategist and the world's greatest authority on sea power, died suddenly at the United States naval hospital at Washington on Dec. 1.

Though he was in his 74th year, Admiral Mahan was in apparently good health until the European war began which excited him greatly. The first month of hostilities deeply affected him. There were great demands made upon him for comments as a naval expert, and during the early days of the war he gave many interviews and wrote a number of articles dealing with the contest. The demands on him from American and foreign publications was cut short by President Wilson's order prohibiting American military and naval officers from commenting on the conflict, but Admiral Mahan, while discontinuing his writings on the war, never lost interest in it one moment. Signs of organic heart disease developed in September, and recurred late in October, just before Admiral Mahan came to Washington.

Admiral Mahan was as familiar with Europe, her history, and armaments, as he was with American history, and knew many of the men actively identified with the war in high places in England, Germany and France. Some of his intimate friends among the military and naval men in Europe had lost their lives in the war and this shocked him. Some of these officers he met in his travels, and when he received honorary degrees at Oxford and Cambridge and many more when he went to The Hague in 1899 as American Naval delegate to the First Peace Conference.

There were distinct reasons why the American people congratulated themselves upon the presence of Admiral Mahan, then Capt. Mahan, in the First Hague Conference. He was not only a naval strategist and scholar, but was even then regarded as the most eminent living expert in naval strategy. Then he had always consistently advocated strong navies and preparedness for war with special reference to naval influence in making for peace. Added to his equipment as a diplomatist in the delicate and complex task before The Hague Conference was his experience as a public man who had been hailed as the first great exponent of the philosophy of sea power.

Book Made Him Famous

His great reputation had been developed in the nine years immediately preceding the first Hague conference. It was in 1890 that his first book of international importance, "The Influence of Sea Power Upon History," was published in Boston and made the author known around the world.

Admiral Mahan himself has told how it was that he came into the greater work—how, when reading Mommsen in the English Club at Lima, he was struck with that historian's failure to recognize the all-important influence of sea power on Hannibal's history. He wrote out the whole outline of "The Influence of Sea Power," discussed it with Admiral Luce, and then set to work with painstaking method. He chose the term "sea power" with the deliberate purpose of challenging attention. He is the coiner of that term in its present significance.

Admiral Mahan was born at West Point, N. Y., Sept. 27, 1840. His father was D. H. Mahan, an eminent Professor of Engineering at the United States Military Academy. On Nov. 17, 1896, Admiral Mahan was retired on his own application, after 40 years' naval service, in order to be able to devote himself to his writings on sea power. Once since then he has been called to active duty—in May, 1898, when he was appointed a member of the Naval War Board, commonly known as the Strategy Board, during the war with Spain.

Admiral Mahan was a man of most interesting and admirable personal traits. Slender and erect, he was about 6 feet 2 inches tall, with finely chiseled features, very blue eyes, and a closely-cropped Vandyke beard. He was soft and gentle in voice and had a pleasant but reserved manner, perhaps a little cold to those who did not know him well. He was a man of high religious ideals.

The Navy department issued this tribute to Admral Mahan:

"Admiral Mahan became famous as an author and historian in the early nineties, when his books on 'The Influence of Sea Power Upon History' and 'The Influence of Sea Power Upon the French Revolution' were published. These were followed by a 'Life of Nelson.' These books were classics in their line, and were widely read throughout the world. In England and Germany in particular they received the highest commendation, and in evey country possessing a navy they became veritable text books in naval strategy. In England the leading naval men of the day confessed that it had remained for him to elucidate the work of the British navy in a way that they themselves had never understood or even dreamed of.

"Since the first books he has written many of lesser importance, and these and his essays have kept him before the world as the greatest modern writer on naval strategy. He was a close student of world politics, and his writings on the trend of the politics of the leading nations of the world were accepted as an authority. It may be safely said that no writer of modern times evinced a keener insight in the affairs of the world or expressed himself concerning them more clearly and convincingly than did the late Admiral Mahan.

"His death will cause international regret not only because of the high esteem in which he is held in every country of the world interested in naval affairs, but also because of the fact that his death leaves a void among naval and political authorities of the world that no author and writer can fill."

The Terry Steam Turbine Co., Hartford, Conn., has appointed Fidanque Bros. & Sons of New York and Panama as their representatives for the republic of Panama and the Canal Zone. The Cleveland office of the Terry Turbine Co. has been moved from 710 New England building to 503 Union building, L. G. Finlay in charge.

George W. Bath, who had charge of the Pittsburgh Steamship Co.'s engineer school for the five past years, has opened a school in the Rockefeller building, Cleveland.

THE MARINE REVIEW

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There Is Help For It

Under the caption "Is there no help for it?" the *Marine Journal*, of New York, publishes the following editorial:

The toll of human life exacted of mariners on the Great Lakes every fall before navigation closes is a close second, if it does not exceed, that exacted by the elements on the Grand Banks, while in both cases the lives of officers and crews are sacrificed for the purpose of furnishing their fellow-citizens with food, the fisherman from the depths of the sea (fish food) and the lake mariner in bringing food from the soil (grain) to the more largely populated cities of the east. While the demand for fresh fish in winter cannot be supplied in any other way than from the deep sea and its attendant dangers, land products can be transported by rail at all seasons of the year, taking more circuitous routes, however, and at greater cost, but without the usual fall sacrifice of the lives of many of the carriers.

We are quite unfamiliar with lake transportation only through what we read and learn from those engaged in it. Lack of sea room in which to wear out a gale appears to be the chief reason for so many vessels being cast away on the shores of the Great Lakes, and doubtless the lack of power to keep the heavily laden vessels off the shore. Ways and means are being continually agitated to reduce the loss of life on the ocean. We have yet to learn of any concerted movement being inaugurated on the Great Lakes to prevent these losses of life and property such as occurred in the gale of the 18th on Lake Superior when a score or more lives were sacrificed, an occurrence of almost every fall within our memory.

It is rather surprising that usually so well informed a man as Capt. Norton is should be, in this particular, so wholly uninformed. It is true that an unpredented storm in November, 1913, destroyed considerable shipping on the lakes with a regrettably heavy loss of life, but three deep-sea vessels went down in that very storm on the lakes. The storm was one of those unmeasured disturbances of nature against which man cannot adequately provide. No storm of meteorological record on the lakes ever equalled it in sustained violence; nor does any navigator recall one. The safety of lake navigation cannot be fairly gaged by such an event because it may never occur again; yet since that great tragedy lake navigators as a rule avoid encounters with the elements, while the owners have strengthened the vessels in parts where damages from the great storm indicated possible structural weakness to exist in the vessels that survived. Every vessel owner on the lakes has given definite instructions to his masters that the safety of the ship and crew is the first consideration. The master is the sole judge of weather conditions and he is not expected to put out if, in his judgment, it is imprudent to do so. As a rule navigators do not leave port if weather conditions are threatening and those that are out usually seek shelter. The accidents on the lakes were very few during the season of 1914 and no modern vessel was lost through the elements at any time during the year; nor, in fact, has there been any storm this year that a modern carrier could not have weathered easily, but they are as a general thing avoided. The three craft that went down on Nov. 18 were lumber carriers, a type which is necessarily old because, as the trade itself is a dying one, no new vessels are ever built for it. But the loss of a lumber carrying vessel is rare on the Great Lakes because these are the ones that exhibit the greatest caution of all. But time and chance happeneth to all men and to all things and these three vessels were unfortunately caught in an exposed position when the gale broke and with no shelter convenient. The statement in the *Marine Journal* does not rest upon proper support. There is concerted action on the lakes to minimize accidents. The proof of that lies in the fact that the leading vessels carry 25 per cent of their own insurance. In fact, there is no place in the whole world where there is a finer concert of action to eliminate accidents and to safeguard life.

An American Merchant Marine

The newspapers report that President Wilson is determined to again push the proposition to formulate a government-owned steamship line to carry our products abroad. This seems to us to be the most foolish proposition that has ever been seriously entertained. What possible good such a merchant line would do is beyond understanding. Does the President really believe that an American merchant marine can be built up in that manner? It would seem to us to be the most effectual means of crushing what little marine we have. No man in his senses is going to compete with a government-owned line. The banking and business interests of the country should attack this proposition with vigor because it strikes at the very roots of private initiative. Nothing could be contrived that would make steamship securities worthless collateral quicker than this.

There is one way of acquiring an American merchant marine and only one, and that is by recognizing the handicaps under which capital now operates in the over-sea trade and removing them by government aid. Not only does it cost more to build a ship in this country, but it costs more to operate it under the American flag than under the flag of any other nation. These facts should be frankly recognized by Congress and frankly compensated for.

Lake Carriers' Assembly Rooms

NOW that navigation is definitely over the assembly rooms maintained in the various cities along the lakes by the Lake Carriers' Association have been thrown open for the convenience of the men employed aboard ship. During the fall a committee of the association made a tour of the lakes, visiting all the rooms and putting them into proper shape for the winter. These assembly rooms have grown in usefulness and convenience from year to year until they are now a recognized part of the sailor's life during the winter period. They are extremely club-like and have all the conveniences that are incidental to clubs. The reading rooms are well supplied with current periodicals and magazines and the usual form of indoor amusements. Every room is supplied with a victrola and the circulating library of records is quite extended, embracing both classical and popular selections. Shower baths and dressing facilities are installed in a majority of the rooms, as well as a checking system whereby the sailor's personal belongings may be safely left in the care of the custodian.

A noted improvement has taken place in the seamen's quarters at Buffalo, which are now located on the corner of Washington and South Division streets. These rooms are large and have unusually pleasant surroundings and the association considers itself fortunate in having obtained such desirable quarters. In connection with the seamen's quarters at Buffalo, a room has been furnished for the exclusive use of the officers during the navigation season.

New quarters have also been secured at Toledo, located at 511 Summit street, and have conveniences installed similar to the Buffalo quarters, having a separate room for licensed officers.

Assembly rooms at Lorain, located at 657 Broadway, have been fitted up with shower baths and other conveniences and are thrown open for the first time during the winter period.

The quarters at Milwaukee have also been practically doubled in space by the removal of partitions so that the quarters in that city are now unusually commodious.

The assembly rooms are liberally patronized and have developed a spirit of comradeship among the men hitherto unknown. Aside from being pleasant resting places, they have also been a source of real help along educational lines. This was clearly demonstrated by the commissioner at Duluth who inaugurated a school among the seamen at that port during the winter of 1912 for teaching spelling, reading, writing and arithmetic. The school was of an entirely informal character, but so keen was the interest taken in it, that last winter these assembly room schools were extended to Buffalo, Detroit, Cleveland, Marine City, as well as Duluth. They were well patronized in all of the cities and the opportunity to acquire the rudiments of education were eagerly seized by a number of the men. Night schools will be maintained in the same cities during the present winter and a large attendance is being looked forward to. The practical value of these schools is proved by the fact that out of a class of 30 at Marine City last winter, who were definitely instructed in navigation and engineering, 15 were enabled to obtain licenses, being about equally divided between the forward and after ends of the ship.

Following is the personnel in charge of the various rooms:

Buffalo—Licensed officers' room:—Custodian, T. Howard Saunders; house committee, Capt. Walter Robinson, Capt. E. L. Shaw, Wm. T. Smith, C. E.

Cleveland—Engineers' room:—Custodian, H. W. Wellet; house committee, E. D. Butler, H. B. Moore, Harry Edmonson.

Cleveland — Masters' and mates' rooms:—Custodian, L. C. Lister; house committee, Fred C. Sturtevant, Ernest H. Pollock, Gustav Olsson.

Detroit—Licensed officers' room:—Custodian, A. D. Biddlecom; house committee, L. P. Anderhalt, Oscar P. Stevenson, John A. McCarron.

Algonac—Assembly room:—Custodian, Capt. George B. Kendall; house committee, Capt. H. A. Stewart, E. T. Everill, C. E., Capt. S. H. Smith.

Marine City—Licensed officers' room:—Custodian, J. H. Currie; house committee, F. B. Parker, C. E., Capt. A. W. Henry, Capt. James E. Cottrell.

Marine City — Seamen's assembly rooms:—Custodian, Capt. P. J. Cullen.

Port Huron—Licensed officers' room:—Custodian, H. J. Nelson; house committee, Capt. A. P. Chambers, Capt. W. P. McElroy, A. J. Armson, C. E.

Seamens' Rooms

Buffalo—Custodian, A. H. Limerick.

Conneaut—Custodian, William Ford.

Ashtabula—Custodian, W. F. Norris.

Cleveland—Custodian, L. C. Lister.

Lorain—Custodian, Ben Schaeffer.

Toledo—Custodian, Hugh Ross.

Detroit—Custodian, F. C. Hintz.

South Chicago—Custodian, C. W. Stephenson.

Chicago—Custodian, Richard Eaton.

Milwaukee—Custodian, J. McJesky.

Duluth—Custodian, W. A. Bourke.

Iron Ore Shipments

Iron ore shipments during the season of 1914 were 32,021,897 tons as against 49,070,478 tons for the corresponding season of 1913, a decrease of 17,048,581 tons or practically one-third. A small cargo of 1,411 tons was shipped in December from Escanaba which is included in the November shipments from that port. The trade was flat and lifeless throughout the entire season, at no time exhibiting any animation whatever and closing without a single spark of energy. It is noted, however, that during the past two weeks a certain liveliness has manifested itself in pig iron and some furnaces are sold out until next April. As practically no reserves of ore were brought down, as would be in normal periods, it is reasonable to expect that with any kind of activity in pig surplus stocks will be low when navigation opens again. Those that are therefore looking forward to an early movement of vessels in the spring are doing so logically.

Shipments during November and for the season of 1914, with corresponding data for 1913, are shown in the following table:

Port.	Nov., 1913.	Nov., 1914.
Escanaba	485,102	*223,459
Marquette	194,720	104,147
Ashland	281,476	133,673
Superior	929,368	389,279
Duluth	810,973	121,248
Two Harbors	569,319	98,286
	3,270,958	1,070,092
1914 decrease		2,200,866

Port.	Season, 1913.	Season, 1914.
Escanaba	5,399,444	3,664,451
Marquette	3,137,617	1,755,726
Ashland	4,338,230	3,363,419
Superior	13,788,343	11,509,748
Duluth	12,331,126	6,318,291
Two Harbors	10,075,718	5,610,262
	49,070,478	32,021,897
1914 decrease		17,048,581

*Includes 1,411 tons shipped in December.

Captain Samuel Gould, who for several years conducted the Pittsburgh Steamship Co.'s nautical school, has opened a school at his home 1595 East Eighty-sixth street N. E., Cleveland, Ohio.

Safety of Life From Fire at Sea*

By W. O. Teague

SAFETY first! These words of warning are rapidly becoming familiar, particularly to the traveling public of the United States of America, due to the wide publicity being given them by chambers of commerce and other public-spirited organizations. Printed signs bearing the warning are being prominently displayed on railway trains, street cars and other means of conveyance on land, but I have not seen or heard of such signs appearing to any appreciable extent on ocean steamers and vessels carrying passengers on the rivers, sounds and lakes of this country. It would seem, therefore, that the safety campaign has not yet been extended to this field, which involves great possibilities of loss of life and of serious injury to travelers on water.

The greatest sources of danger are shipwrecks and fires. Improvements in the construction of vessels, life-saving and signaling apparatus, particularly wireless telegraphy, and the adoption of stringent rules and regulations governing navigation have gradually reduced the losses from shipwrecks, but there has been little progress made in safeguarding life from fires.

The awful cry of "Fire" is always terrible and startling, but more so on shipboard, where every circumstance of danger and horror is intensified. Most vessels are still built of wood, and although the advent of steel for the hull, and in some cases decks and bulkhead, has reduced the amount of inflammable construction, the fixtures and contents are still composed of highly inflammable materials; and when fire starts, particularly at sea, it often consumes the vessel or causes it to sink. The passengers meanwhile have little choice between death by fire or drowning.

Statistics regarding loss of life from fires at sea are fragmentary. Records of the United States bureau of navigation, department of commerce and labor show the following losses of life on American steamers:

Fiscal year ending June 30,	Number of steam merchant vessels totally destroyed by fire.	Number of lives lost on these vessels.
1906........	53	12
1907........	56	48
1908........	58	5
1909........	57	16
1910........	93	23
Total.....	317	104

It should be noted that the loss of life given above is only that which occurred on vessels totally destroyed, whereas the probable loss of life on vessels only partially destroyed is equally large. Figures are not available previous to 1906, but if we include the 957 lives lost on the General Slocum in 1904, it would bring the average number of lives lost by fire on American steam merchant vessels alone, for the seven years noted, up to 200 per year. The average loss of life by burning of steamers of all nationalities must, therefore, be very large.

These statistics also show that the average number of American steamers totally destroyed by fire each year is over 60, while in addition there are about 140 vessels of miscellaneous type destroyed, making the total average 200 per year. The destruction of vessels of all nationalities must, therefore, be large.

Name of vessel.	Date burned.	Location.	Passengers and crew.	Lives lost.
New Horn	1619	Off Madagascar	.....	200
Prince	July 26, 1752	Off Portugal	.....	300
Kent	Mar. 1, 1825	Arctic Ocean	.....	96
Ocean Monarch	Aug. 24, 1848	Off Lancashire	218	178
Amazon	1852	Bay of Biscay	162	104
Austria	Sept. 13, 1858	Atlantic Ocean	538	471
Japan	Dec. .., 1873	....	.....	391
Wawassett	Aug. 8, 1874	Potomac River	.....	82
Cospatrick	Nov. 18, 1874	Atlantic Ocean	476	473
Seawanhaka	June 28, 1881	East River, New York	.....	40
General Slocum	June 15, 1904	East River, New York	1,388	957
Volturno	Oct. 19, 1913	Atlantic Ocean	657	136

The number of vessels completely destroyed by fire may not seem large when it is considered that throughout the world there are probably 50,000 vessels continually in service. At the same time the possible loss of life and probable destruction of property consequent on fire should encourage consideration of all possible methods of preventing outbreaks and arresting fire in the early stages.

The following is a list of vessels destroyed by fire resulting in serious loss of life at sea, not including fires following shipwrecks:

Typical Fires

A brief reference to several of these fires will illustrate general experience. The British steel steamship Volturno was abandoned on fire at sea October 10, 1913, in the Atlantic ocean en route from Rotterdam to New York, and later was sunk. There were 136 lives lost out of 657 passengers and crew.* The vessel was loaded with a general cargo consisting of chemicals, oils, rags, peat moss, straw bottle covers and mats, and large quantities of wine and spirits, all highly inflammable goods. The fire started in one of the forward holds and was fought with water from hose streams and steam. The hatches were burned so that the steam had practically no extinguishing effect, and, as the crew were unable to direct the hose streams on the fire, it continued to burn itself out. The holds were not flooded for fear of foundering, as there was a very high sea running, which also prevented the lifeboats being launched from the Volturno or the several liners which had been summoned to her aid by wireless. Oil poured on the waters by the tank steamer Narranganset the following day finally permitted the rescue of those still alive.

The wooden steamer Amazon was burned in the Bay of Biscay in 1852, on her first voyage. The loss of life was 104 out of 162.** Fire started during the night time in the engine-room from overheating of the engine bearings, and its rapid spread prevented the engineer from shutting off steam, so that the vessel continued at a speed of some thirteen miles per hour. This made it impossible to launch the lifeboats until the steam supply was exhausted. Several boat-loads were gotten away, and these were rescued later.

Probably the greatest loss of life from fire on shipboard was caused by the burning of the paddle-wheel excursion steamer General Slocum, June 15, 1904, in the East River, New York. The total loss of life was 957 out of 1,358 passengers and 30 crew.* The vessel was of wooden construction throughout, with three decks. The light wood of the upper decks had been painted and varnished many times and was therefore in a highly inflammable condition. In the construction of the vessel there were no safeguards against fire other than compliance with the regulations as regards the proximity of

*Paper read at meeting Society of Naval Architects and Marine Engineers, New York, Dec. 10 and 11, 1914.

*From "The Burning of the Volturno," by Arthur Spurgeon.

*From report of the United States Commission of Investigation.

**From "Great Shipwrecks."

woodwork to boilers. The vessel had no fire proof hatches or bulkheads. In such a vessel a fire, once having obtained fair headway, could not be controlled and the vessel would be quickly consumed, as occurred in this instance.

The fire started in the forward cabin, so called, this being the third compartment under the main deck from the bow, and probably originated in a barrel containing packing hay, communicated to it through the carelessness of some unknown person. The cabin was used as a lamp room and general storage room. At the time of the disaster it contained four barrels of cylinder, machine and mineral oil, also a large number of paint pots and kegs and various other ship's stores and rubbish. In brief, this cabin was in an excessively unsafe condition as regards fire.

There were available on the main deck for fighting this fire a line of cheap linen fire hose supplied with water from a good steam fire pump and twenty fire buckets which were empty when fire started. The hose burst and was rendered useless upon turning water into it. The fire spread rapidly and the vessel was beached, but in the meanwhile the people were obliged to jump overboard. It was learned later that no fire drills or boat drills had taken place on the vessel that year. The inefficiency and poor quality of the deck crew, doubtless typical of the majority of the crews of excursion steamers, was one of the essential facts that caused the loss of so many lives. One of the fundamental facts which made possible a disaster of so extreme a nature was the character of the material and form of construction of the General Slocum, and in this respect the Slocum was no more dangerous than are scores of steamers still carrying passengers in the port of New York and hundreds of similar vessels elsewhere. The sole protection of such a vessel against fire depends on prompt extinguishment at its early inception.

Causes of Fire

The most frequent causes of fires on passenger steamers are spontaneous combustion of coal in the bunkers and of certain raw materials in the holds and storerooms such as cotton waste, wool, oakum, jute and materials of a similar nature, which when damp take fire on heating; the ignition of volatile oils in the storerooms, such as gasoline, alcohol, turpentine, etc., by the striking of matches, breaking of incandescent electric lamps, tipping over of oil lanterns and candles, or other open flame; overheating of bearings of the machinery; ignition of woodwork or other combustible materials in contact with steam pipes and uptakes or stacks, and defective electric wiring.

The first essential for the prevention of fire is the use of noncombustible material in the construction of the vessel and its fittings. The hull and important bulkheads and decks of ocean liners are made of steel and this construction is used for the better class of coastwise, sound, lake and river steamers. The greater portion of all these vessels is combustible, however, and the partial use of steel has not materially lessened the possibility of destruction by fire.

It is entirely practicable to substitute light steel for wood, but thus far the increase in cost of about 10 per cent for medium and large passenger steamers has been considered prohibitive. The only other objection raised to the use of steel is that a uniform temperature below decks can not be readily maintained. There are non-combustible insulating materials now available to line the steel, which construction gives good results. Wood carvings, panel work, etc., can also be duplicated in metal for partitions and furniture. Plaster of paris and similar materials are now used in modern liners for decorative effect.

A number of paints have been claimed to fireproof wood and thus remove this objection to its use, but this claim has been discredited since tests have demonstrated that, while the paint retards somewhat the ignition of the wood, it does not reduce its combustibility in the least.

The next important feature of prevention is to subdivide the vessel into comparatively air-tight compartments, and fortunately the design of passenger steamers lends itself readily to this construction. The watertight bulkheads, both transverse and longitudinal, form fire stops similar to divisions walls in factories. The decks still further retard the spread of fire, especially when made of steel, and the small cabins and other compartments with non-combustible enclosures confine a fire so that it may be readily extinguished if proper facilities are available. Fireproof doors should be fitted to all important door openings, and these should be normally closed or be automatically self-closing in case of fire.

Where wooden decks are used, a clear space should be left where the smokestack passes through and the exposed wood faced with asbestos and sheet steel. Similar protection should be provided for galley stove-pipes. Combustible goods of all sorts should be kept away from these flues and other hot pipes. The galley should be lined with metal and have a non-combustible flooring. The safest location for the galley is on an upper deck.

Cleanliness of the vessel is very important, and particularly in the case of storerooms, closets, etc. The engine-room should be kept free of excess oils and the supply of these limited. Oily waste should be stored in metal waste cans of approved type until removed.

Lamp rooms are required by law to be metal lined and have an oil-tight floor. When oil lamps are used they should have metal bodies and be securely fastened in place. Any woodwork over them should be protected by metal shields. Torches are much used in the engine and boiler rooms but are not very hazardous if not left lighted.

Electric light wires should be run throughout in approved iron conduit. Switchboards should be of slate or other non-combustible material and be set clear of woodwork back of them, which should also be fireproof with steel or asbestos or both.

Fire Protection

The most effective fire-extinguishing agent, water, is of course always available in unlimited quantity, but to obtain the best results it must be properly applied.

Flooding.—The simplest method would be to immerse the burning vessel, but this can be done only to a limited extent because of the danger of foundering and drowning of all on board. Before the days of steam machinery, water from outside was allowed to fill that portion of the vessel in which the fire occurred, but this did not prove efficient since the water level could not rise sufficiently to submerge the entire hold and its contents, and the fire was thus permitted to spread to other portions of the vessel. In the case of the Volturno none of the holds was flooded for fear of foundering, which demonstrated that this method of extinguishment is not always practicable and that it is quite inefficient.

Fire Pails and Chemical Extinguishers.—For incipient fires the water bucket has always been useful, and even today it forms an important part of the fire-protective equipment on shipboard and also in factories and miscellaneous buildings ashore. The records of the Associated Factory Mutual Fire Insurance Companies show that fire pails extinguish the majority of fires occurring in some three thousand factories insured by them.

The so-called chemical extinguishers have also come into use on shipboard in addition to the fire pails, and sometimes improperly in place of them. There are several types of these extinguishers, the principal ones being the three-gallon soda and acid extinguisher and the smaller, usually one quart, extinguishers utilizing carbon tet-

rachloride liquid as the extinguishing agent. The soda and acid extinguisher is in principle a water pair arranged to more effectively distribute the water under pressure. The addition of the chemicals does not increase the efficiency of the liquid to any appreciable extent. The principal weakness of this extinguisher is that it may not be in an operative condition when needed, but this can be largely remedied by occasional inspection and test of it.

The tetrachloride extinguisher depends upon the smothering effect of the chlorine gas, which is liberated when the liquid comes into contact with the flame, for extinguishment, and the extinguisher is effective only in small enclosed spaces such as closets, etc., where the gas can be confined. The liquid has but little cooling effect, especially since it evaporates rapidly, with the result that the embers will again burst into flame, thus requiring constant use of the liquid to insure complete extinguishment. The chlorine gas also renders the use of the extinguisher impossible in large spaces where the firemen have to gain access to reach the fire. For these reasons the tetrachloride extinguisher should only be depended upon to extinguish incipient fires in enclosed spaces.

Hose Streams and Fire Pumps.—Manually operated pumps and later steam pumps with fire hose have proven effective when brought into use before the fire has assumed large proportions. The discovery of the fire usually takes place after it has gained considerable headway, and the consequent delay in bringing the fire hose and pump into use forms a serious weakness of this method of protection. Furthermore, it is difficult and frequently impossible to direct the streams at the source of the fire because of the inaccessibility to numerous parts of the vessel's compartments and the inability of the firemen to withstand the smoke and heat at a point near enough to apply water. The hose streams are very effective, however, as a secondary line of defence in preventing the spread of fire by wetting and cooling down the structure contiguous to the burning area, and as a means of final extinguishment after the fire has been gotten under control.

The arrangement of the system proposed by the International Convention for the Safety of Life at Sea provides that every vessel shall have powerful pumps; on vessels less than 4,000 tons there shall be two, and on larger vessels three of these pumps. The capacity of the pumps shall be such that they can deliver a sufficient quantity of water in two powerful jets simultaneously in any given part of the vessel. The fire service mains are to be arranged so that two streams can be simultaneously directed on any given part of a deck occupied by passengers and crew, when the watertight and fireproof doors are closed. Provision is also to be made so that two streams may be conveyed to every space filled with cargo.

Steam.—The advent of the steam engine for propulsion of vessels made steam available for fire extinguishment. The steam extinguisher was first favored and required by the United States government for use on passenger and freight steamers, and it is now in general use for the protection of cargo spaces on steamers of practically all nations.

Steamboat Inspection Service

The general rules of the U. S. Steamboat Inspection Service requires the following arrangement of steam-extinguishing apparatus for ocean, coast-wise, lake, sound and river steamers. "The main pipes and their branches, on steamers carrying passengers or freight, to convey steam from the boilers to the hold, and separate compartments of the same shall be not less than 1½ inches in diameter. * * * Steam pipes of not less than ¾ of an inch in diameter shall be led to all lamp lockers, oil rooms, and like compartments, which * * * compartments in all classes of vessels shall be wholly and tightly lined with metal. All branch pipes leading into the several compartments of the hold of the vessel shall be supplied with valves, the handles distinctly marked to indicate the compartment or parts of the vessel to which they lead. These valves or their handles shall be placed in the most accessible part of the main deck of the vessel and so arranged that all can be inclosed in a box or casing, the door of which shall be plainly marked with the words, 'Steam fire apparatus.' Pipes for conveying steam from the boilers * * * for the purpose of extinguishing fire, shall not be led into the cabins or into other passengers' or crew's quarters."

Upon the discovery of fire efforts are first made to close the openings to the compartment involved and then open the valve on the steam-pipe to it, the smothering effort of the steam being depended on to extinguish the fire. Experience has demonstrated, however, that it is frequently impracticable or impossible to close the compartment, as instanced in the burning of the Volturno aforementioned, under which condition the steam has practically no extinguishing effect, and even when confined the steam is not a very effective extinguishing agent, especially if used after the fire has gained considerable headway. In fact, tests have been made on shore where combustible materials were completely burned, although enclosed in an atmosphere of steam.

Steam will damage a valuable cargo as much as water and, besides, it is very wasteful. In one case of fire on an Atlantic liner, in which cotton was burned in the holds, so much steam was used that the engine nearly stopped, thus preventing the vessel from rushing to the nearest port for assistance. Furthermore, since the steam is applied only to the holds, it forms at best only a partial protection.

Gases.—Several gases which are non-supporters of combustion have been used to a limited extent to replace steam, and these have proven to be good fire-extinguishing agents when the fire is confined. The gases are not as effective as water, however, in absorbing heat and have but little cooling effect on the fire.

Of these gases carbon dioxide (CO_2), is perhaps the best known to the American public, since it forms the familiar soda-water drink. The gas is compressed to liquid form in steel tubes containing about 40 pounds, and these are connected to the pipe distribution system. While it can be made on shipboard, the process would be too complicated for quick use and also quite expensive.

The use of the gas is objectionable since it causes asphyxiation, although a person could live a limited time in an atmosphere containing 15 per cent of gas, while 40 per cent is necessary to extinguish fire. A 40-pound tube is required for each 1,000 cubic feet of air space. This objection is not serious, however, as the gas is proposed for use in the holds only, and there is small possibility of any of the crew being in there when on fire. The gas is non-injurious to merchandise.

The arrangement of the pipe distribution system is similar to that for steam previously described. Since the gas is heavier than air the outlets are placed at the ceiling, and in operation the gas will descend through the cargo, filling crevices and interstices which could not be reached by water except by flooding. When the necessary amount of gas has entered the compartment the fire is extinguished, and the gas can then be removed by an air pump piped to the bottom of the hold.

Another gas is sulphur dioxide (SO_2), and this is being exploited today for this use. It is said to have been in use for years and to have successfully extinguished fires at sea. An apparatus is on the market for making

the gas on shipboard. Commercial sulphur is burned in a specially designed furnace connected to the holds by a double line of piping. Air is drawn from the holds through one pipe by a high-powered blower and discharged into the furnace, where it is converted into sulphurous gas, which in turn is forced back into the hold through the second line of piping.

Thus oxygen is replaced by non-combustion supporting gas. When the gas contents have reached a certain percentage the burning sulphur is cut off, and the gas-laden air in the hold is circulated by the same machine through a cooler which forms its base, and fresh air is gradually admitted. The cooling-down process can be observed and regulated at the machine.

So-called fire indicators are fitted to the machine with connections to the chart room. In operation air is drawn from the various holds and any rise in temperature is indicated. It is claimed that this machine is now used on vessels of 2,000,000 tons gross tonnage.

The use of this gas has been considered objectionable since it causes asphyxiation, an atmosphere containing only 3 per cent of the gas being fatal to life. It is also said to be injurious to certain kinds of merchandise.

The use of nitrogen gas has also been experimented with. This gas is made by forcing air through a confined burning body, whereby instantaneously the nitrogen and oxygen of the air are disengaged and free nitrogen with an occasional trace of carbon dioxide gas given off.

Carbon Dioxide Gas

The boilers of steam vessels at sea are constantly producing and discharging through the smoke-stack a similar mixture. The apparatus which has been designed to utilize these gases for fire extinguishment consists of a blower with suction piped to the uptake flue over the boiler; a cooler made of a coil of pipe water-jacketed placed in the suction pipe so that the gases may pass freely into the usual pipe distribution system. Valves are provided on pipes to cabins, etc., in which people are apt to be present, so that the gases can be discharged as the rooms are vacated.

Automatic Sprinklers.—In the foregoing I have briefly outlined the history of fire protection on shipboard and described present general practice. The automatic sprinkler, which has been in use particularly in factories during the past thirty years, has proven to be a great conserver of life as well as property. The records of the Boston Manufacturers Mutual Fire Insurance Co. show that since 1874 there were only five lives lost by fires in about 3,000 factories thus protected. There are employed in these factories 1,500,000 people. In all the factories equipped with sprinklers in the United States and Canada there are 2,225,000 employes who are safe from fire. The fire records show, however, an appalling loss of life in factories not protected by automatic sprinklers.

Safeguard to Vessels

In spite of these well-known facts the application of this safeguard to vessels has only just begun, the delay doubtless being due to the additional expense of a sprinkler system, there being no direct return on the investment. The estimated cost of a sprinkler equipment on shipboard, exclusive of the pumps and tanks, would be about $4 per sprinkler, these being spaced about 10 feet apart, each one protecting 100 square feet.

The automatic sprinkler is in principle a ½-inch globe valve having a soldered link or strut to hold the valve disc tight on its seat against water under pressure in the pipe system. The sprinklers are located near the ceiling and spaced about 10 feet apart. In event of fire the solder melts, releasing the valve cap, and water is distributed all round in a dense spray. Where the compartment is not heated in winter, as in storehouses or the holds of vessels, the pipe system is maintained under air pressure at about 35 pounds, a special device, termed a dry pipe valve, being installed in the main supply pipe in a heated enclosure to hold back the water until fire opens a sprinkler when the valve trips and water is permitted to flow into the system.

On shipboard the water can be maintained under pressure by continued slow operation of the steam fire pump, using an automatic governor or a large tank nearly filled with water with air above kept under pressure by intermittent operation of a small air pump, the fire pump to be started as soon after discovery of fire as possible.

The limited capacity of the pressure tank and the possibility of the air pressure lowering are sources of weakness, but it seems entirely feasible to overcome these on large steamers by the use of a gravity supply by providing a tank built in the form of an extra smoke-stack. For steamers with several stacks, large water-jackets could be fitted to them to provide the supply.

There are a number of coastwise, sound and lake steamers already fitted with sprinkler systems, and several ocean liners have partial systems. The steel steamer Alabama operating on Lake Michigan has automatic sprinklers on the dry-pipe system in the holds and passenger and crew quarters. There are 300 sprinklers in all, each of those in the holds covering from 80 to 120 square feet, and one being installed in each inner stateroom and a number in the hallways, stairways, locker spaces, etc. Sprinklers were not provided in the outer staterooms as these are more accessible for the use of hose streams and other appliances.

There are two 2½-inch hose connections on the main deck with 200 feet of 2½-inch hose and fifty 1½-inch hose connections with 2,500 feet of 1½-inch hose distributed over the several other decks. In the engine-room there are the following steam pumps: 1 duplex, 600 gallons capacity; 1 fire engine duplex, 1,200 gallons; 2 single, 180 gallons; 3 feet, 390 gallons; the total capacity being 3,330 gallons per minute. On the forecastle deck there is a hand deck and fire pump of 50 gallons capacity.

The steel and wooden steamer Commonwealth operating on Long Island Sound has 1,800 automatic sprinklers distributed throughout the interior of the steamer, staterooms and lockers, not exceeding 8 feet from center to center in any place. This system is divided into thirty circuits, each with a 4-inch diameter main from a manifold located in the engine-room on the main deck.

To this manifold the main discharge from a 16-inch by 12-inch by 12-inch duplex fire pump is connected. This pump at all times maintains a pressure at the manifold of 100 pounds per square inch and is fitted with a governor to maintain this pressure in case of the opening of any of the circuits and sprinklers, and is also fitted with a throttle by-pass which can be operated from the main engine-room.

Thermostat System

Supplementary to this system is a thermostat system with mercury thermostats located not over 12 feet centers with all wires run in conduit, and divided into circuits corresponding with the sprinkler circuits. This system terminates at two annunciators, one in the main saloon and one in the engine-room, indicating the circuit number. The opening of a valve of corresponding number on the sprinkler system manifold supplies water to the sprinklers at the fire.

In addition to the two main annunciators on the thermostat system, small annunciators are located throughout the saloons to determine the location of a fire within a range of a few staterooms. All the annunciator drops, besides showing the circuit number, in-

dicate the location on the steamer and ring 8-inch alarm bells located in the crew's quarters, engine-room and saloons.

While this sprinkler system will undoubtedly prove efficient if the valve is opened while the fire is in an incipient condition, the chances are that there will be some appreciable delay and the fire be beyond control. It must be borne in mind that the great efficiency of sprinklers on land has been due to their automatic and immediate action, which can only be accomplished by maintaining the system under water pressure or where there is liability of freezing by maintaining air pressure in the system, using a dry-pipe valve. Experience has shown that the slight delay in discharge of water with the dry-pipe system does not materially reduce the efficiency of the sprinklers.

There are sixty-five hose connections located throughout the steamer, connected by copper fire mains with the fire and wrecking pumps, a 50-foot length of hose is attached to each outlet, and the location is such that all portions of the steamer are protected. A large donkey boiler located on the main deck is connected to all fire and sprinkler system pumps, and steam is kept up night and day when the vessel is laid up for the winter months or for repairs. A watchman's time detector is connected with thirty-eight recording stations so located that in order to make a proper record the wachman must pass through every section of the ship.

Automatic Sprinkler System

The ocean liners Imperator and Vaterland have 800 automatic sprinklers installed in deck "G" forward from amidship bulkhead to steerage bulkhead and aft from amidships bulkhead to second class cabin bulkhead; in deck "H" forward and aft of the amidships bulkhead. The sprinklered portions of deck "G" are storage compartments, and in deck "H" the crew's quarters. There are two systems, one forward and one aft of the amidships bulkhead for both decks, and they are connected to and are constantly under pressure from the salt water fire main, although the sprinkler piping is normally kept filled with fresh water. There is an alarm valve on each sprinkler riser which operates an alarm electrically connected with the ship's fire headquarters.

There is an automatic fire-alarm system having 450 thermostats placed in the first class cabins forward of the amidships bulkhead, deck "F"; steerage deck "J"; baggage and cargo compartments, deck "K"; provision lockers in the bow, fire decks; second class cabins, deck "E"; second and third class cabins, deck "G"; and provision and baggage compartments on decks "J" and "K." In addition there is a manually-operated fire-alarm system of 28 break-glass boxes and an indicating board in fire headquarters.

Fire mains extend throughout with hose connections and hose so placed that every part of the ship can be reached. The supply is from fire pumps in the engine-room. Chemical extinguishers are placed in the corridors. A steam system is connected to the holds and carbonic acid gas from the ship's refrigerating system can also be used.

Fire and Boat Drills

In order to safeguard life from fire at sea it is of the greatest importance that the crew be trained to use the fire-protective appliances and also the life-saving apparatus in an efficient manner in addition to providing these facilities. The crew as a whole should be instructed in the use of hand extinguishers and fire hose. A muster list should be prepared and definite stations and duties assigned to each man to insure prompt and systematic use of the protective appliances and apparatus. Fire and boat drills should be held to familiarize the men with their stations and duties.

The International Convention has adopted the following requirements covering these matters:—"Special duties for the event of an emergency shall be allotted to each member of the crew. The muster list shows all these special duties and indicates in particular the station to which each man must go and the duties he has to perform. Musters of the crew at their boat and fire stations followed by boat and fire drills respectively shall be held at least once a fortnight either in port or at sea."

It is an unfortunate fact that these precautions are usually considered a useless waste of time and effort, which attitude is probably due to the false feeling of security engendered by the absence of frequent fires on any one vessel, not realizing that the next fire may destroy the vessel; and also, since the owners may not be insistent that the drills be carried out, appreciating that they involve some additional expense in operation of the vessels.

The more promptly a fire is discovered, the better chance there is of extinguishing it. Acting on this principle, watchmen patrol the unfrequented portions of a vessel, and to check their movements a recording clock is used with key stations at various points throughout the route.

Avoidance of delay in giving an alarm of fire is likewise important. Electrically operated alarm systems are the most efficient, either automatic, using thermostats, or manual, or both may be used.

I have pointed out serious losses of life from fire at sea, the most frequent causes of fires on passenger steamers, practicable methods of prevention and present-day practice in fire protection of these vessels, together with suggestions for improvements, the most important of which is the use of non-combustible material and automatic sprinklers. There is little doubt but what shipowners appreciate the advantages of carrying out these improvements, but for commercial reasons they cannot afford to do so.

Most owners would take every available precaution against loss of life and property from fire if some inducement were given them such as a subsidy, so that they would not be at a disadvantage with vessels not so equipped. In the course of time practically all vessels would be on the same basis, so that the subsidy could be discontinued.

Protected by Sprinklers

The fact that some vessels are already protected by sprinklers will gradually come to the notice of the traveling public and it would be entirely proper for the owners to advertise the increased safety of their vessels, with the result that these steamers will be favored with greater patronage, thus making it necessary for the owners of other vessels to do likewise. People now prefer to stop at hotels which are of the fire-restrictive construction and have been fitted with modern fire-protective appliances. They also consider the increased safety and comfort of riding in steel Pullman cars worth the extra cost. A great disaster from fire at sea similar to that of the Titanic from collision with an iceberg, the possibility of which is very much greater than the public realizes, would bring about an immediate demand for greater safety and an exclusive patronage for protected steamers on which the possibility of loss of life from fire would be reduced to a minimum.

The new ocean liners in particular are being equipped with larger engines to obtain greater speed and are also provided with more costly fittings to increase comfort at the demand of the public who are willingly paying larger fares to obtain these advantages. Their safety is of even greater importance, and there is no doubt but what this will be appreciated in time and that shipowners will meet their demands as soon as it is commercially practicable to do so.

New Niclausse Marine Boiler*

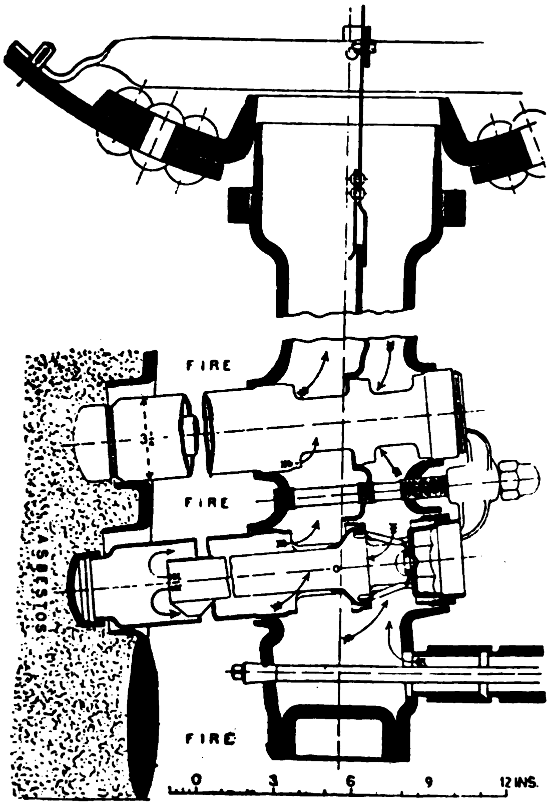
By Jules Niclausse

THE Niclausse boiler, of which so many important installations have been made in practically all the navies of the world, in large power-houses and in industrial factories, is too well known by engineers to require a description, so the author proposes to limit this paper to setting forth briefly the general features and latest improvements.

In the Niclausse boiler all the evaporating tubes are fitted at one end only into the headers, and a perfectly tight joint is ensured my metal-to-metal conical joints. The other end is closed by a cap and is carried by a supporting plate. The removal of any tube, either for cleaning or for replacement, is very easily and rapidly effected, so that a shut-down for any cause does not put the boiler out of service for more than a relatively very short time. The tubes being fixed at one end only, expansion or contraction takes place freely, giving complete security against troubles resulting from neglect of this important provision. It will be noticed from Fig. 1 that the old screwed-on lantern end has been suppressed, the tube being now solid drawn throughout, with swellings to form the cones.

As shown in Fig. 1, each header is divided into two compartments by a vertical partition plate, separating the steam and water currents. The current of water flowing through the front compartment of the header is distributed to each evaporating tube by an inner tube contained in the former. Windows cut in the header end of the evaporating tube enable the water to enter and the steam to depart in two distinct currents, so that positive circulation in only one, and that the correct direction, is ensured.

During the last two years, a number of improvements have been made in the details of the Niclausse boiler, without affecting the principles of its operation and construction. Some years ago the malleable cast-steel curved headers were replaced by headers constructed in solid drawn pressed steel of increased and of rectangular section, and recently the firm introduced a special system of feed distribution to serve the lower tubes, which are those nearest the furnace, and are the principal evaporating tubes. For this purpose, the steam and water drums are divided into two compartments by a longitudinal diaphragm plate in prolongation of the vertical partitions in the headers, as shown in Fig. 2; the feed, after passing through a trough *C* wherein carbonates and other impurities are precipitated, and whence they are ejected by means of a blow-down valve *D*, enters at the front compartment, descends the vertical headers for a certain distance determined by a cross diaphragm *E*, passes into the upper evaporating tubes and returns with the steam there produced into the back compartment of the drum, which consequently contains only hot and purified feed. The purified feed then descends by two tubes placed in front of the side walls, in the case of the high-duty boiler, Fig. 3, into a square horizontal header located longitudinally in front of, and connecting by an elbow to the bottom of each of the vertical headers. The upper tubes are therefore fed by relatively cold feed-water, and the bottom tubes by the purified hot feed. The horizontal header also serves as a "bottom box", Fig. 2, whence im-



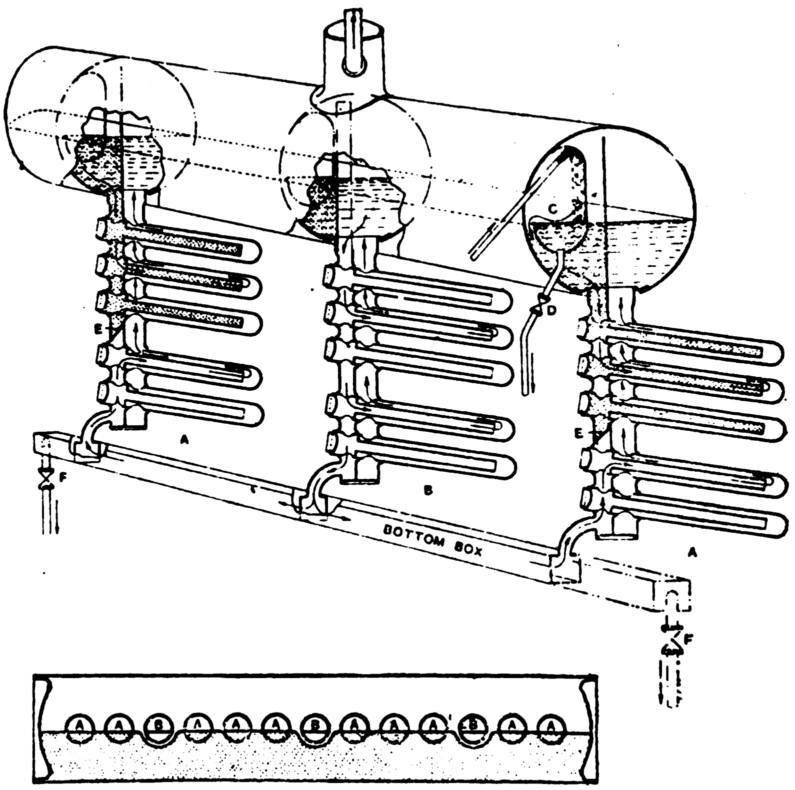


FIG. 1—HEADER AND EVAPORATING TUBE ENDS. FIG. 2—DIAGRAM OF WATER CIRCULATION IN LAND TYPE OF BOILER. AREAS COVERED BY SMALL DOTS REPRESENT COLD FEED WATER

*Read at the Paris meeting of the Institution of Mechanical Engineers.

purities can also be rejected by blowdown valves *F*, fitted at each end of it.

The lower tubes, which are most exposed to the heat of the furnace, consequently receive the feed at boiler steam temperature and free from any impurities which can cause deposit. Any impurities in the feed to the upper tubes are practically harmless, since the temperature of the gases surrounding them is insufficient to form a hard scale.

In the modern land-type boilers the system is simplified, without impairing its efficiency, by suppressing the vertical downtake pipes. These are replaced by one header out of every four or five, in which no cross diaphragm is fitted in its front compartment, so that it serves to feed the "bottom box" and the lower tubes of all the headers fitted with the cross diaphragm, whilst its own lower tubes are served direct. The arrangement will be quite clear from Fig. 2, *A* being headers having the cross diaphragm in their front compartment taking impurified feed from the front side of the drum to feed the upper tubes. *B* being a downtake header taking its hot purified feed-water from the back side of the drum, the division plate therein being suitably arranged for this purpose, as shown at *B* in plan.

High Duty Marine Type Boiler

In the new high-duty marine type boiler, the firm have still further increased the section of the headers, chiefly in the rear compartment forming the passage for the steam. This is about 4½ times larger than in the modern land-type headers. Furthermore, an inclination of 15 per cent. instead of 10 per cent. has been given to the tubes, in order to facilitate disengagement of the steam. Also, the outside diameter of the tubes has been reduced from 84 mm. to 60 mm. (3$\frac{5}{16}$ to 2⅜ inches), a reduction which has been rendered practicable, with complete security against all forms of distress, by the above-mentioned improvements.

The new high-duty boiler is fitted with a feed-reheater placed above the tubes. The water circulates into this apparatus on the contra-flow principle, that is, in the reverse direction to the hot gases. The official tests referred to hereafter show the efficacy of this feed-reheater, as much from the point of view of the feed-water temperature as from that of the chimney-gas temperatures.

The high-duty marine boiler having no superheater as usually arranged between the tubes in the land type, is fitted with a new system of gas baffling, which doubles the length of the gas flow in the tube "faisceau," ensuring improved utility and efficiency. This comprises plain open-ended tubes laid between the evaporating tubes, forming gas passages, as will be seen from Fig. 3.

All the above improvements were comprised in the test boiler recently tested by the French navy experts. Full dimensions of this boiler are given in the Appendix, together with a drawing showing its general arrangement, Fig. 3. The tests of this boiler by the committee of naval experts appointed by the French Admiralty, and carried out in September last, comprised:—

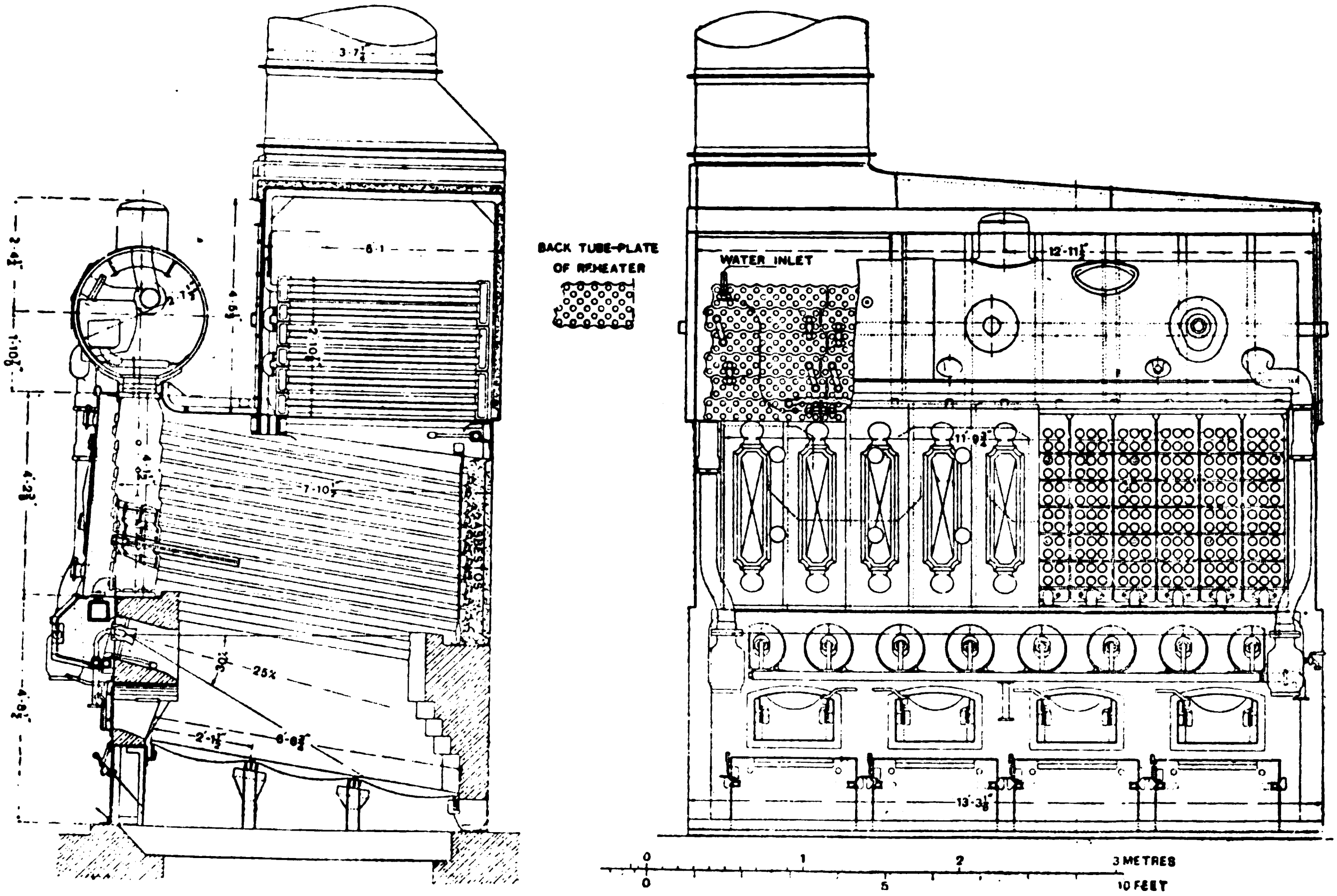


FIG. 3—HIGH DUTY MARINE BOILER FOR NEW FRENCH BATTLESHIP BEARNE

(1) A six-hour trial at the combustion rate of 95 kilograms of coal per square metre of grate surface (19.5 lb. per square foot). The evaporation in pounds from and at 212 degrees Fahr. was 13.1 per pound of coal fired, the thermal efficiency being 91.5 per cent and the capacity, 20,000 pounds per hour from and at 212 degrees Fahr.

(2) A six-hour trial at the combustion rate of 180 kilograms of coal per square metre of grate surface (37

pounds per square foot). The evaporation in pounds from and at 212 degrees Fahr. was 11.5 per pound of coal fired, the thermal efficiency being 79.8 per cent.

(3) A sixteen-hour trial at the combustion rate of 225 kilograms of coal per square metre of grate surface (46 pounds per square foot). The evaporation in pounds from and at 212 degrees Fahr. was 11.4 pounds of coal fired, the thermal efficiency being 79.3 per cent, and the capacity 41,000 pounds per hour from and at 212 degrees Fahr.

(4) A four-hour trial at the combustion rate of 135 kilograms of petroleum per square metre of grate surface. The evaporation in pounds from and at 212 degrees Fahr. was 15.5 per pound of fuel burnt, the efficiency being 78.8 per cent.

Elasticity of the Boiler

(5) A five-hour trial to demonstrate the elasticity of the boiler. Operation took place as follows: Half an hour at the combustion rate of 95 kilograms per square metre of grate surface; half an hour at the combustion rate of 95 kilograms per square metre of grate surface; half an hour at the combustion rate of 180 kilograms; half an hour at combustion rate of 225 kilograms; one hour at the combustion rate of 240 kilograms; a quarter of an hour at the combustion rate of 180 kilograms; a quarter of an hour stop; ten minutes at the combustion rate of 95 kilograms; three-quarters of an hour at the combustion rate of 135 kilograms with oil fuel; a quarter of an hour at the combustion rate of 95 kilograms of coal. This trial proved that the boiler made the change from these different rates with perfect success, and without any difficulty.

Further tests were made on the 6th January last, by a party of English engineers. The results fully corroborated those obtained by the French naval experts.

During the No. 3 trials, the percentage of water entrained was at maximum only 0.9 per cent. This was determined by the salt method with the Kennedy apparatus. The maximum temperature of the gases at foot of chimney was only 330 degrees Cent. (625 degrees Fahr.) during the sixteen-hour test at the combustion rate of 225 kilograms per square metre (46 pounds per square foot), when the evaporation was 105 per cent above the normal. It must be added that the feed-water used was the ordinary town water, which was not in any way treated or purified, and which during the official tests was subjected to an addition of such a quantity of sea salt as to give one degree of salinity to the water in the boiler. Valvoline was also added in the proportion of 175 grammes per ton of coal fired. On the results of the tests made by naval experts in September last, the French Admiralty placed with the firm an order for twenty-one boilers, aggregating 36,000 horsepower for the 25,000-ton super-Dreadnought *Bearne* laid down on the 1st January of this year.

For land service, the new high-duty boiler is arranged in much the same manner as in the Niclausse land type, and is fitted with super-heater and mechanical stoker, both of the firm's design and make. The superheater is constructed of several serpentine sections interpolated and coupled to two headers, one at the entrance and the other at the steam exit. The serpentines, which are placed within the nest of tubes in the latter, are located above the "faisceau" in the new high-duty type boiler for land service.

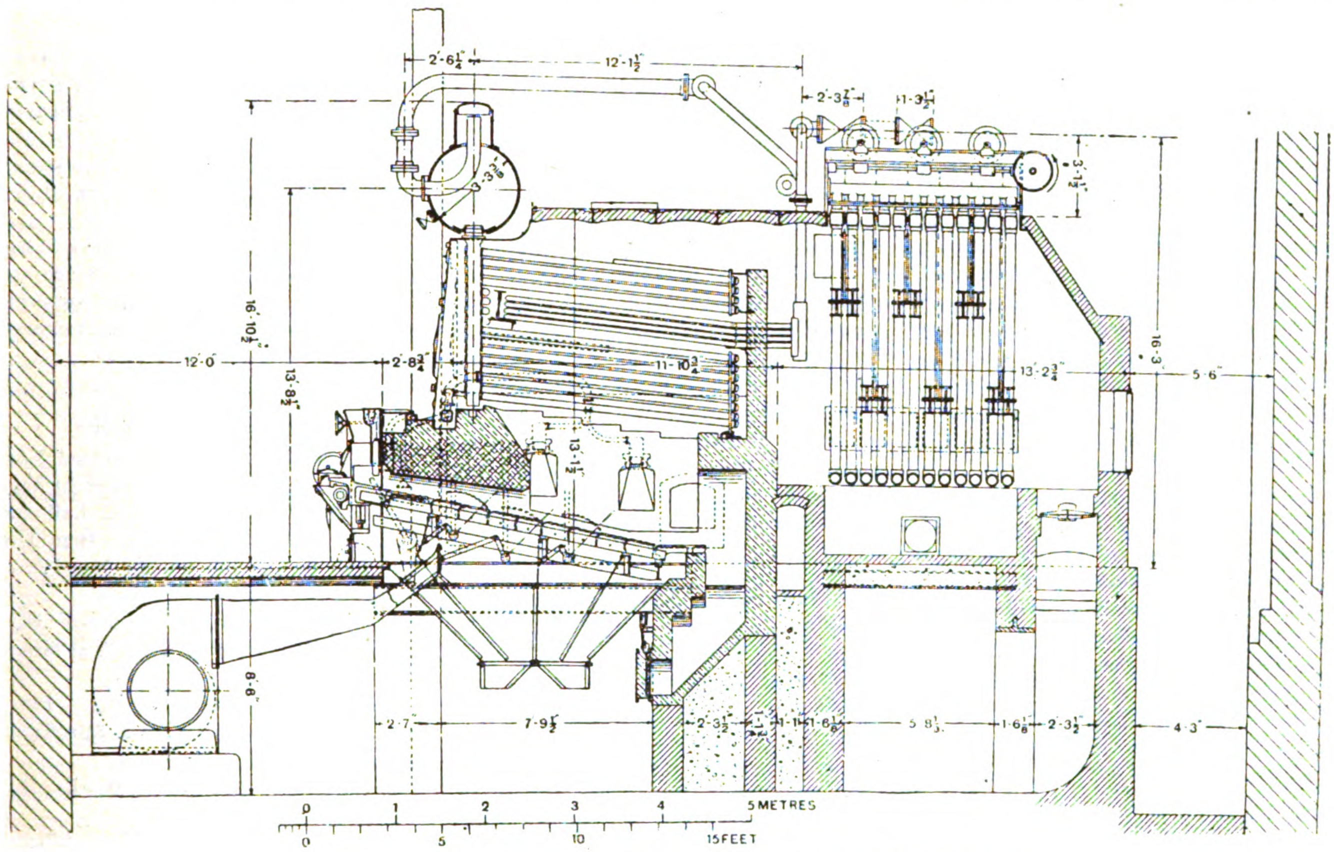


FIG. 4—CROSS SECTIONAL ELEVATION OF SOUTHEND BOILERS

Niclausse Mechanical Boiler

The Niclausse mechanical stoker comprises fire-bars in short sections interlocking each other and carried in supporting bearers, which are given an intermittent to-and-fro motion, so that two adjacent bars always work in opposite directions. There is a momentary cessation between the movement backwards and forwards. The bar movement is effected by means of a slowly rotating shaft mounted with hard steel

cams, which engage with hard steel trip pieces mounted on the bearer heads. The speed of the driving shaft can be varied from one to six revolutions per minute. Below the grate are fitted a series of hoppers serving as both air-ducts and ash-pits. The air supply is furnished preferably by a forced draught fan worked at low pressure. This system is very much more economical than either the induced or ejector draught systems. The ash-pit is divided into three compartments, in which the air supply is regulated independently to the different zones of the fire-bed, whereby perfect combustion with any kind of fuel is ensured. The ash-pit compartments also serve to separate green fuel riddlings from the fine ashes, the former being trapped in the front compartment and the latter in the rear compartment, whilst the clinkers are delivered into a capacious hopper under the end of the grate. The Niclausse stoker, of which there are over 200,000 horsepower at work, has been proved capable of burning all classes of solid fuels from coke breeze and coals having only 8 per cent volatile matter to the coals richest in volatile matters. Recently, it has been tried in England with very high volatile Midland coal, and in South Wales with extremely low grade, low volatile, high ash Welsh coal, with successful results.

Fig. 4 illustrates the arrangement of the stoker, also the superheater, with respect to the boiler, as instanced in the recent installation of two 25,000 to 35,000 pounds per hour boilers, complete with stokers, etc., at the Corporation Electricity Works of Southend-on-Sea in England.

APPENDIX

Particulars of the boiler submitted for trials by the navy.

The general arrangement of the boiler is shown in Fig. 3. Other particulars are as follows:

Working pressure (gauge), 18 kilograms per square cm. (256 pounds per square inch).

Number of headers, 13.

Number of evaporating tubes, upper, 300 (thickness 2½ mm. (0.099 inch).)

Number of evaporating tubes, lower, 156, (thickness 4 mm. (0.16 inch).)

Total number of tubes 456.

Cleaning of tubes, 12.

Outside and inside diameter of upper tubes, mm., 60 x 55 (2.36 inches x 2.16 inches).

Outside and inside diameter of lower tubes, mm., 60 x 52 (2.36 inches x 2.04 inches).

Height of headers, 2.300 m. = 7 feet 6 inches.

Length of tubes projecting outside the headers, 2.020 m. = 6 feet 7¼ inches.

Number of tubes in economizer, 780.

Length of economizer tubes, (outside headers), 1.216 m. = 4 feet 0 inches.

Length of grate, 2.000 m. = 6 feet 6 inches.

Width of grate, 3.600 m. = 11 feet 9¾ inches.

Grate area, 7.20m² = 77.5 square feet.

Heating surface of outer tubes, 173.62m² = 1,870 square feet.

Heating surface of economizer, 119.22m² = 1,285 square feet.

Total heating surface, 292.85m² = 3,155 square feet.

The ratio of outer heating surface of the tubes (neglecting the header surface) to the grate surface is:

Outer surface of evaporating tubes .... 24.11 to 1
Outer surface of economizer tubes .... 16.56 to 1
Ratio of total heating surface to grate area. 40.67 to 1

Space occupied by boiler = 114 square feet, height to top of dome 13 feet.

Hourly evaporation per square feet of ground space occupied:

(a) At normal load, with rate of combustion of 19.5 pounds per square feet of grate surface = 175 pounds per hour from and at 212 degrees Fahr.

(b) At overload, with rate of combustion of 46 pounds per square feet of grate surface = 355 pounds per hour from and at 212 degrees Fahr.

New Royal Mail Steamer

On Thursday, Nov. 19, Harland & Wolff, Ltd., Belfast, launched the large, steel, triple screw passenger steamer Almanzora for the Royal Mail Co.'s South American mail service. The Almanzora is nearly 600 feet long x 67 foot beam, and will be about 15,600 tons gross. She is a triple screw vessel, and will have a combination of reciprocating and turbine engines. To meet the requirements of the frozen and chilled meat trade, the Almanzora will be provided with an extensive installation of refrigerating plant and insulated chambers.

The luxurious character of the passenger accommodation in the Royal Mail steamers is well known, and in the Almanzora special care is being taken to ensure that the decorations will satisfy the most aesthetic taste, the style of the different rooms being varied, with a view to insuring the most artistic effect. In the first class there will be suites-de-luxe, consisting of bedroom, sitting room and bathroom, intercommunicating state cabins with bathroom attached, and a large number of single and double berth rooms, many of which will be fitted with bedsteads instead of berths. Most of the inside cabins will be arranged on the tandem principle, thus giving natural light and ventilation to them. All cabins will be tastefully decorated, well ventilated, and fitted with electric light and fans. The dining saloon will be beautifully decorated, and fitted with small tables on the restaurant style to accommodate about 400 people. There will be a children's saloon adjoining the main saloon. The two smokerooms will be richly upholstered, and in addition to the handsomely decorated social hall there will be a daintily furnished ladies' boudoir.

The Almanzora will be fitted with a passenger lift serving five decks, gymnasium, barber's shop, dark room for photography, cloak room, inquiry office, and servants' rooms. The promenade decks will be spacious. Special attention is also being paid to the second and third class accommodation, which will be a distinct feature of the vessel.

During construction the vessel has been under the superintendence of Capt. G. M. Hicks, marine superintendent, and James E. Wimshurst, superintendent engineer.

Bids for Steel Hull

The following bids were received Nov. 19 by the United States engineer at Cincinnati for furnishing a steel hull for the dipper dredge Carrollton. Item 1 is delivered at Carrollton and item 2 as designated by bidder:

Hartmann Greiling Co., Green Bay, Wis., item 1, $13,280; 2, $11,280, at Green Bay.

Jones & Laughlin Steel Co., Pittsburgh, Pa., item 1, $10,925; 2, $10,655, at Pittsburgh, Pa.

Dubuque Boat and Boiler Works, Dubuque, Ia., item 1, $17,546.

Charles Hegewald Co., New Albany, Ind., item 1, $9,459; 2, $9,399, at New Albany, Ind.

Milwaukee Bridge Co., Milwaukee, Wis., item 1, $10,740.

Ed. J. Howard, Jeffersonville, Ind., item 1, $10,450; 2, $10.350, at Jeffersonville, Ind.

Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa., item 1, $10,138; 2, $9,-938, at Neville Island, Pa.

American Bridge Co., Cincinnati, O., item 1, $8,888; 2, $8,525, at Ambridge, Pa.

Rock Island Bridge and Iron Works, Rock Island, Ill., item 1, $9,028.

The bid of the Great Lakes Dredge & Dock company, of Chicago, Ill., $29,-942.50 in amount, has been accepted for dredging in the Chicago river, Illinois.

Lloyds Register of Shipping

The Activities of the Society During the Year Have Been Great—Nearly 24,000,000 Tons of Shipping Classified

THE annual report of Lloyds Register which has just been made public shows 23,870,665 tons classified by the society of which 6,270 of 13,782,899 tons are British and 4,351 of 10,087,766 tons are foreign.

During the year the Committee assigned classes to 713 new vessels. Their registered gross tonnage, amounting to 2,020,185 tons, is the highest total for any one year recorded in the history of the society. Of the 713 new vessels, 664 are steamers of 2,014,397 tons and 49 are sailing vessels of 5788 tons, all constructed, in accordance with approved plans, under the special supervision of the surveyors to Lloyds Register. Of the total, 1,204,111 tons, or about 60 per cent, were built for the British Empire (United Kingdom 1,164,519 tons; Colonies 39,592 tons), and 816,074 tons, or about 40 per cent for other countries. During the twelve months ended June 30, 1914, plans of 749 vessels, representing 1,650,000 tons of shipping, were passed by the committee.

VESSELS CLASSED IN LLOYDS REGISTER BOOK AT JUNE 30th, 1914

Material of construction and description.	British. No.	British. Tonnage.	Other countries. No.	Other countries. Tonnage.	Total. No.	Total. Tonnage.
Iron and steel:						
Steam	5,925	13,462,113	3,711	9,056,636	9,636	22,518,749
Sail	237	306,440	634	1,029,843	871	1,336,283
Wood and composite:						
Steam and sail......	108	14,346	6	1,287	114	15,633
Total	6,270	13,782,899	4,351	10,087,766	10,621	23,870,665

Geared Turbines

A feature worthy of mention in connection with the progress of marine engineering is the increasing use of steam turbines. To obtain economy with steam turbines a high peripheral velocity is necessary. This can only be realized by obtaining a high speed of rotation or by using rotors of very large diameters, the latter method being only practicable when large powers are required. In the earlier vessels fitted with steam turbine engines, the turbines were coupled direct to the screw shafting. When very high speeds of rotation are employed with such engines, the economy obtained by using turbines is to some extent neutralized because the propellers are necessarily made of smaller diameter than would be used for the same power if slower speed of rotation could be arranged for. The introduction of geared turbines has enabled a high peripheral speed to be obtained by using comparatively small rotor drums running at very high rates of revolution geared with the screw shaft running at the lower rate of revolutions which would be used with reciprocating engines of the same power, thus combining the high efficiencies of steam turbines and of slow-running propellers. This has been rendered practicable by the accuracy with which it is now possible to cut helical gearing by special machines. There are at present 23 vessels being built to the society's class in which geared turbines are to be fitted. In addition, there are 6 vessels under construction in which direct-coupled turbines are to be used, and also 6 in which the engines will be a combination of reciprocating engines using the steam through the high-pressure and first and second intermediate cylinders, but having the low pressure cylinders replaced by a low-pressure turbine. In this arrangement, which has proved satisfactory in practice, there are three lines of screw shafting, the two outer, port and starboard, being driven by reciprocating engines and the centre one by the low-pressure turbine, which takes its supply of steam from both the reciprocating engines. When manœuvring, the reciprocating engines only are used, and they then work independently of the turbine, exhausting directly into the condenser. An advantage of the combination of reciprocating and turbine engines is that the machinery can be worked at reduced power with practically the same efficiency as a full power. The speed of these engines is reduced by "linking-up," enabling the full steam pressure to be utilized in the cylinders, whereas with ordinary steam turbines the speed can only be regulated by varying the steam pressure, so that when less than full power is required the steam pressure has to be reduced and a corresponding loss of efficiency is incurred.

In last year's report reference was made to the increasing employment of oil engines for marine purposes. In view of the importance of this means of mechanical propulsion, the committee has now issued rules for the construction and survey of Diesel engines and their auxiliaries, and it has also, in the recent issue of the Register Book, introduced a separate list of motor vessels, with all necessary particulars. There are in service at the present time 27 vessels holding the society's classification which are fitted with Diesel engines, the collective horsepower being approximately 50,000 indicated horsepower, and 20 others are in course of construction with a view to classification. Of vessels fitted with oil engines of other than the Diesel type there are 36 classed with Lloyds Register, and several others are being built to class. The East Asiatic Co. is the owner of six of the classed Diesel-engined vessels referred to in the preceding paragraph, and has also two vessels in which the steam engines are being replaced by Diesel engines. In addition, it has under construction with a view to classification five Diesel-engined vessels, three of which are being built and engined by Messrs. Burmeister and Wain at Copenhagen, and two being built at Glasgow by Messrs. Harland and Wolff and engined by Messrs. Burmeister and Wain at that port. It is worthy of notice that the Selandia, the earliest of the East Asiatic Co.'s vessels, has eight cylinders per shaft, each being 20⅞ inches diameter by 28¾-inch stroke, the total power being 2,500 indicated horsepower. The Siam and Annam, which were built for the company in 1913, also have eight cylinders per shaft, each 23¼ inches diameter by 31½-inch stroke, the power being 3,000 per vessel. The Fiona, one of the company's latest vessels, has six cylinders per shaft, each 29⅛ inches diameter by 43 5/16-inch stroke, the power being 4,000. These are up to the present the largest cylinders which have been used for Diesel engines of merchant ships.

Fitted With Diesel Engines

Among the other owners of classed vessels fitted with Diesel engines are the Nederlandsch-Indische Tankstoomboot Maats, which has six in service, the largest of which has a tonnage of 3,803 tons, with engines of 1,700 indicated horsepower; the Rederi Aktiebolaget Nordstjernan, which has four vessels, each of 3,700 tons, in service, and two of the same size being built, the indicated horsepower in each case

being 2,000; and the Flower Motor Co., which has one vessel of 3,681 tons completed and two more of the same size being built. Several Diesel-engined vessels of larger size, with tonnages ranging from 5,000 to 8,000 tons, are in course of construction on the Clyde, and of these four are intended for British owners.

The use of oil engines for small vessels is also extending and in order to construct such engines in an economical manner it has become usual to build them in batches to standard dimensions. Arrangements have been made by the committee with some of the principal firms which manufacture such engines for a proportion of those they build for stock to be specially surveyed by the society's surveyors throughout construction, and for the materials used to be tested as required by the society's rules. In this way all difficulty is avoided in the event of the engines being ultimately required to be used in classed vessels.

In last year's report allusion was made to the recent revision of the society's rules relating to the burning and carrying of oil fuel. These rules provide for the use of oil fuel, the flash point of which is not lower than 150 degrees Fahr. In some cases, however, it has of late been desired to employ oil having a lower flash point, and the committee has approved plans making suitable provision for the safe use of such oil. In this connection it may be mentioned that fires have occurred in vessels, the fittings of which were only suitable for high flash-point oil, and as these fires might perhaps have been caused by the employment of oil fuel having a flash point lower than 150 degrees Fahr., the committee felt it to be its duty to call the special attention of the owners of vessels in which oil fuel is used to the importance of seeing that their vessels are supplied with fuel of a suitable quality.

An unprecedented number of vessels of upwards of 5,000 tons each have been assigned the 100A1 class during the 12 months ended June 30, 1914. In this period no fewer than 163 of these vessels have been classed. From the date of the last Annual Report to the present time the following vessels, the tonnage of each of which exceeds 10,000 tons, have received the society's classification, viz.:—Aquitania, 45,647 tons, for the Cunard Steamship Co., Ltd.; Orduna, 15,499 tons, for the Pacific Steam Navigation Co.; Euripides, 14,947 tons, for Geo. Thompson & Co., Ltd.; Tubantia, 13,911 tons, and Gelria, 13,868 tons, for the Koninkl-Hollandsche Lloyd; Alaunia, 13,405 tons, for the Cunard Steamship Co., Ltd; Missanabie, 12,469 tons, for the Canadian Pacific Railway Co.; Frederick VIII, 11,850 tons, for Det Forenede Dampskibs. Selsk.; Llandovery Castle, 11,423 tons, and Llanstephan Castle, 11,293 tons, for the Union-Castle Mail Steamship Co., Ltd.; Berrima, 11,137 tons, and Borda, 11,136 tons, for the Peninsular & Oriental Steam Navigation Co.; Kashima Maru, 10,559 tons, and Katori Maru, 10,513 tons, for the Nippon Yusen Kaisha; San Melito, 10,160 tons, San Hilario, 10,157 tons, San Jeronimo, 10,067 tons, and San Nazario, 10,064 tons, for the Eagle Oil Transport Co., Ltd.; and Jupiter, 10,073 tons, for the Deutsch-Amer. Petroleum Ges.

Cunard Liner Aquitania

It is interesting to note that the Cunard company's quadruple-screw turbine steamer Aquitania, 45,647 tons gross, built by John Brown & Co., Ltd., of Clydebank, is the largest vessel which has hitherto received the 100A1 class. In addition to the foregoing, vessels have been built during the year or are now in course of construction, with a view to receiving the society's classification, to the order of the British admiralty, the governments of the commonwealth of Australia, Dominion of Canada, Union of South Africa, Queensland, South Australia, Ceylon, Southern Nigeria, the United States of America, Russia, Argentina, Brazil, Chili and Uruguay.

The latest returns of vessels being built to the society's classification show the same tendency towards the construction of vessels of large tonnage. The returns include the following steamers of 12,000 tons and above, viz.:—Statendam, 32,500 tons, for the Holland-Amerika Line; Belgenland, 27,000 tons, for the Soc. Anon. de Nav. Belge Americaine; Duilio, 22,000 tons, and Giulio Cesare, 22,000 tons, for the Nav. Gen. Italiana; Orbita, 15,600 tons, and Orca, 15,600 tons, for the Pacific Steam Navigation Co.; Conte Rosso, 15,500 tons, for the Lloyd Sabaudo; Ormonde, 15,000 tons, for the Orient Steam Navigation Co., Ltd.; a steamer of 15,000 tons for the Union Steamship Co., of New Zealand; Transylvania, 14,500 tons, and Aurania, 13,500 tons for the Cunard Steamship Co., Ltd.; Metagama, 12,000 tons, for the Canadian Pacific Railway Co.; Fushima Maru, 12,000 tons, Suwa Maru, 12,000 tons, and Yasaka Maru, 12,000 tons, for the Nippon Yusen Kaisha. There are also steamers of 10,000-12,000 tons each being built to the society's classification for the Peninsular & Oriental Steam Navigation Co.; the Shaw, Savill & Albion Co., Ltd.; the Federal Steam Navigation Co., Ltd.; the Anglo-American Oil Co., Ltd.; the Eagle Oil Transport Co., Ltd.; Pierce Bros.; the Stoomvaart Maatschappij Nederland; the Trans-Atlantica Italiana, Soc. di Nav., etc.

In addition to the large number of ocean-going vessels dealt with during the year, plans have been approved for vessels of many other types, including freight steamers for the great lakes of America, and a variety of vessels for channel and river service. Among the special types of vessels built or being built during the past 12 months under the special survey of the society's surveyors, mention may be made of the steamers Atlantic and Pacific, the largest lumber-carrying vessels under the American flag; two vessels for the Russian government and one for the government of the commonwealth of Australia, intended to carry oil in bulk, and specially strengthened in view of their having to supply warships with fuel oil at sea; and an auxiliary schooner yacht being built by Messrs. G. Lawley & Sons Corporation, of Boston, Mass., in the construction of which alloy steels of high tenacity are being employed, thus enabling the scantlings to be substantially reduced, and at the same time fulfilling the society's requirements concerning the structural strength of the vessel. The tonnage classed by the society during the year includes 72 vessels of 429,384 tons built upon the Isherwood system of longitudinal framing. Up to date there have been built, or are in course of construction to the society's classification, 226 of these vessels, totalling 1,182,200 tons gross.

The number of vessels intended to carry oil in bulk which have been classed by the society during the year under review is the largest yet recorded in any one year, namely, 72 vessels, of 402,033 tons, five of these vessels being over 10,000 gross tons each.

The technical committee has had under consideration during the year proposed amendments and additions to the society's rules for the construction of ships and machinery. The principal subjects dealt with by the committee were the following: Rules for the construction and survey of Diesel engines and their auxiliaries; pumping arrangements of vessels fitted with internal combustion engines (other than of the Diesel type) for marine purposes; iron and steel steam pipes; the testing of steel billets intended for marine forgings; additional strengthening at the forward part of the bottom of steamers; amended rules for boats' davits; the measurement of the length of ves-

sels having cruiser sterns; use of soft steel for widely-spaced, hollow round pillars. The recommendations made by the technical committee affecting the above matters were adopted by the general committee, and have been incorporated in the society's rules.

With regard to the rules for the construction and survey of Diesel engines and their auxiliaries, the committee recognizes that, as experience with the Diesel engine for marine purposes is still somewhat limited, and the arrangements for engines of this type are still in a more or less tentative state, the rules must be considered as subject to such modifications as may be shown to be necessary in the course of longer and more extended experience.

Tests of Steel

During the year, 1,215,467 tons of ship and boiler steel were tested by the society's surveyors at home and abroad. At the end of June there were 85 steel manufacturing firms in the United Kingdom and 217 abroad, recognized by the committee for the production of steel for use in the construction of vessels and machinery intended for classification in Lloyds Register Book. Prior to any establishment receiving such recognition it is necessary that the works shall have been inspected and satisfactorily reported upon by the society's surveyors. The society's surveying staff at the end of June, 1914, comprised 360 officers.

During the past year several important changes have occurred in the personnel of the society's surveying staff. Among these changes it is fitting that mention should be made of the great loss the society sustained by the death of Dr. S. J. P. Thearle, chief ship surveyor, who devoted himself with marked ability, zeal and fidelity to the interests of the society, and through it to those of the mercantile marine. Just before his death he had prepared a valuable paper on "The Classification of Merchant Shipping", which was read before the Greenock Philosophical Society as the James Watt Anniversary Lecture for 1914. W. S. Abell, M. E., professor of naval architecture at the University of Liverpool, was selected to succeed the late Dr. Thearle in the office of chief ship surveyor to the society. Mr. Abell had previously been appointed a member of the load line committee, and chairman of the subcommittee for preparing draft rules and tables of freeboard, and investigating the relation of strength of structure to freeboard by making an exhaustive comparison of the varying rules and practice of the several classification societies. Charles Buchanan, who for seven years prior to May, 1914, held the position of assistant to the chief ship surveyor, was promoted by the committee to the office of principal of the chief ship surveyor's staff, and it is regretted that on account of ill health Mr. Buchanan has felt himself compelled to retire from active service at the end of September. Mention should also be made of the retirement at the end of 1913 of T. J. Dodd, who for many years was principal surveyor at Glasgow. He was succeeded in that office by James French, who for some years past had been employed by the committee on special duty in the United States of America. During the past year the committee has increased the number of exclusive surveyors to the society by the appointment of additional surveyors at ports abroad, including Sydney, Rotterdam and Antwerp.

The total length of chain cable tested during the year at the public proving houses in the United Kingdom, all of which are under the superintendence of the society, was 406,131 fathoms, in addition to a large quantity of miscellaneous chains, samples, etc. The number of anchors tested was 9,284. In addition to the above establishments, there were at the end of June 20 anchor and chain cable-testing machines on the continent of Europe, and 23 in the United States of America, recognized by the committee for the testing of anchors and chain cables to be supplied to vessels owned abroad which are classed, or intended to be classed, in Lloyds Register Book. In these cases the necessary tests are required to be carried out in the presence of surveyors to the society.

Refrigerating Machinery Installations

It has been computed that during the year ended June 30, 1914, over 3,500,000 quarters of chilled beef, 2,500,000 quarters of frozen beef, 7,250,000 carcases of frozen mutton, and nearly 6,000,000 carcases of frozen lamb, besides a vast quantity of dairy produce, fruit, etc., were imported into the United Kingdom in steamers fitted with refrigerating installations. The society's surveyors inspect refrigerating machinery installations and appliances during construction, and examinations are also made at the vessel's loading and discharging ports. The number of vessels holding the society's certificate in respect of refrigerating machinery (Lloyds R. M. C.) is now 176, and in addition there are at the present time 32 vessels, mostly of very large carrying capacity, being fitted with refrigerating machinery under the supervision of the society's surveyors. On the vessels already classed 1,158 surveys have been held at loading and discharging ports during the past 12 months.

Insulated barges trading on the river Thames require to be registered annually by the Port of London Authority, which has recently determined to make the production of certificates of survey from this society a condition of the renewal of such annual registration. Regulations for the requisite inspection of barges in pursuance of this decision have been adopted by the committee of Lloyds Register, which is now prepared to issue certificates in respect of such barges upon receipt of satisfactory reports from the society's surveyors.

Wireless Telegraphy

The number of vessels to which freeboards were assigned by the society under the merchant shipping act, 1894, up to June 30, 1914, was 17,314. The number to which freeboards were assigned during 1913-14 was 530, representing an approximate gross tonnage of 1,840,770 tons.

The past year has witnessed a remarkable increase in the use of wireless telegraphy and submarine signaling in the world's mercantile marine. There are now recorded in the society's Register Book 2,750 vessels fitted with wireless telegraphic installations as compared with 1,932 at a corresponding date last year, and 930 fitted with submarine signaling apparatus as compared with 806 last year.

There are 642 yachts of 111,378 tons classed in the society's Register of Yachts. Of these, 279 of 98,943 tons are steam vessels, and 297 of 7,131 tons are sailing vessels, while 66 of 5,304 tons are fitted with internal combustion engines. Included in the foregoing are 192 built in accordance with the rules for the construction and classification of yachts of the international rating classes under the inspection of the society's surveyors. These vessels have all received the special class R in the society's Register. Sixty of them have been built abroad.

The Coston Signal Co. and the Coston Supply Co. recently moved to their new location, 24 Water street, New York. The new quarters afford the company increased facilities for the sale of their life and property saving devices and contractors' supplies. The company was organized in 1840 and the present officers are: A. L. Coston, president; J. W. Becherer, vice president, and E. A. Beck, secretary and treasurer.